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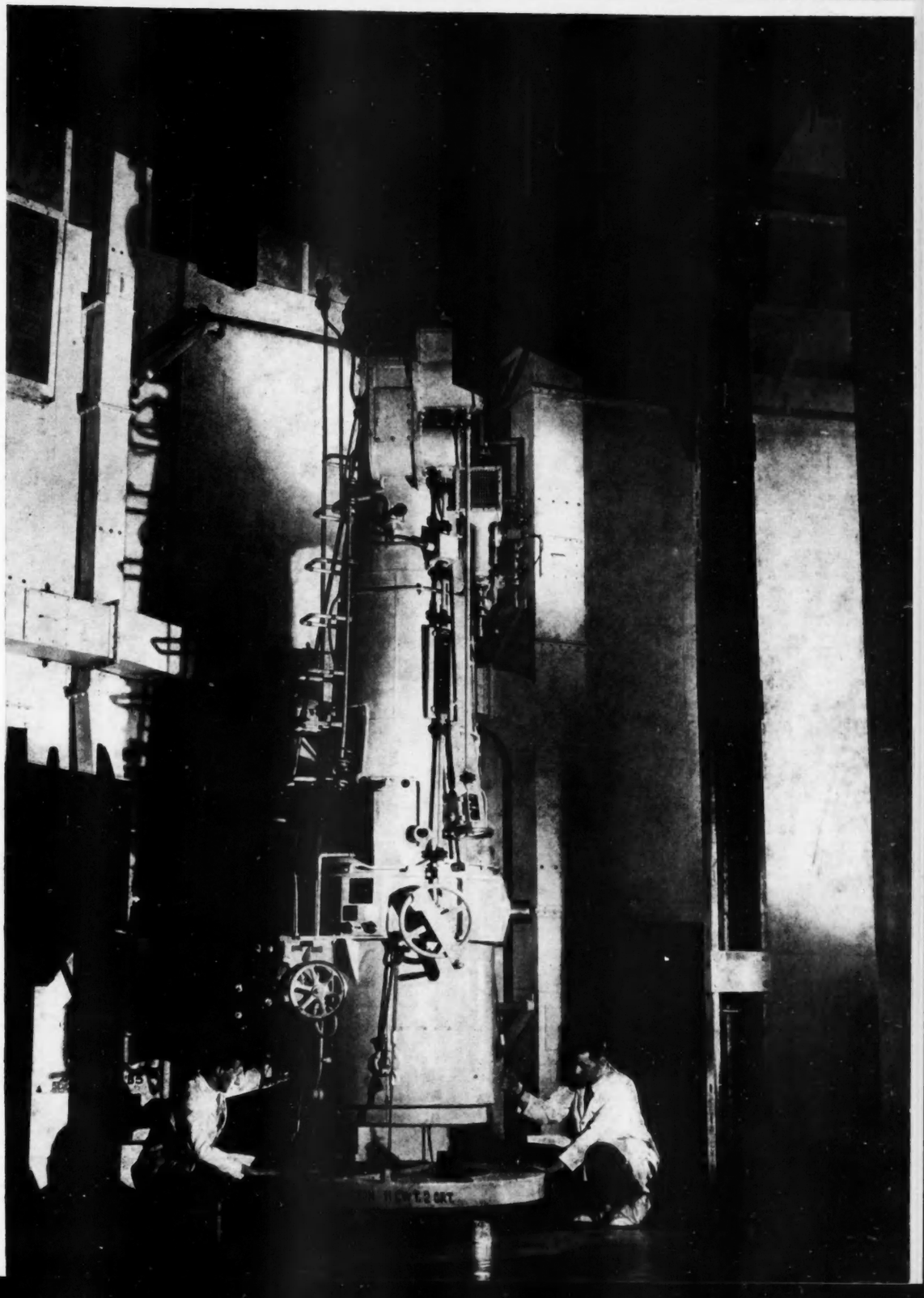

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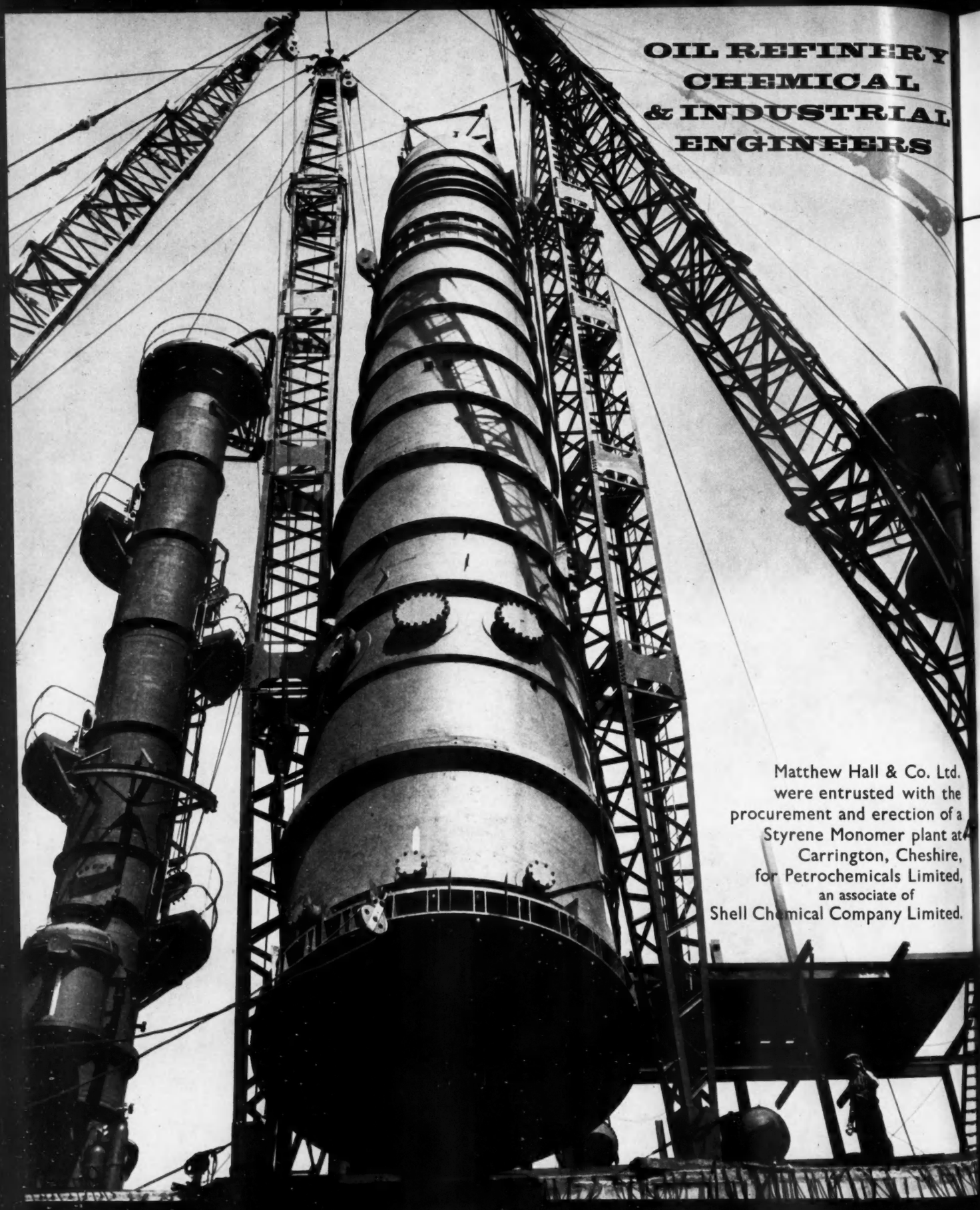

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Contents

397 **Leading Article**
Noise Annoys

398 **Plain Words**

398 **Weekly Survey**

399 **Letters to the Editor**
Engineers' Earnings
Automobile Asymptote
Britain's Waterways

403 **Exhibitions and Conferences**

404 **Meetings and Papers**

406 **Atomic Review**

408 **Special Article**
Aeronautical Exhibits at Science Museum

412 **Automobile Engineering**
Brakes on the 1960 Models

417 **On the Shelf**

417 **Publications**
American Investment in British Manufacturing Industry
Vibration and Shock Isolation—A Survey
Editorial Notes from "Concrete and Constructional Engineering"

418 **New Books and Trade Publications**

428 **At Home**
Kitchen Helps

400 **New Plant and Equipment**
Air Flow Switch, Miniature Timer, Hand Drill, Air Extractor, Self-Propelled Staging, Roll Crusher, Air Compressor, Vacuum Refiner, Plate Bending Rollers, Portable Air Heater, Beryllium Monitor, Sander, Label Marker, Edge Locator, Stroboscope, Storage Racks, Mobile Steps

405 **The Human Element**

410 **Construction**
Concrete Architecture in Scandinavia
Spiral Anchorages for Prestressed Concrete
Weekly Construction News

413 **Companies in the News**

414 **Research and Development**
Design for an Ocean Going Research Ship
Ship Research Facilities at NPL

419 **Metals and Materials**
New Duplex Chromium Resists Corrosion
Polycarbonate is all Embracing, Epoxy Model in Free Flight, Inflatable Metal Tubing, Golden Aluminium Jubilee, Honeycomb Resists Rocket Blast, Improved Gunmetal

421 **Design**
Hydrostatic Tractor Drive Easy to Handle
Gas-Turbine Water Pump for Fire Fighters
How to Prevent Undercooling in Condensers
Design Picture Page
Diesel Engine Starting Made Easy
Parts Feeder Solves Handling Problems
Multiple Car Trains for Suburban Service

425 **Production**
Cutting Out Waste in Cutting Up Strip
Testing Typewriters

426 **Operation and Maintenance**
Hard Facing Reduces Maintenance Costs

427 **Marketing**

ENGINEERING *Appointments Section faces page 142*

Noise Annoys

We don't need research to tell us that noise is irritating and fatiguing. We know how positively unbearable it is anywhere near a road drill at work, or a jet aerodrome, or a radio on full volume next door or even a running tap. We do need research, however, to tell us more about the cause of noise; research that gets to the root of the evil. There is no point in half measures that reduce the noise level merely by fitting a silencer. What is needed is sophisticated design, based on research, that attacks the problem at its source and kills the noise before it starts.

Noise research seems to be heading in the right direction, for only today (30 October) the Acoustical Investigation and Research Organisation (AIRO) Limited are opening an acoustical research station at Hemel Hempstead. Industry will be encouraged to make full use of the facilities offered. The laboratory, developed in close consultation with the National Physical Laboratory and the Building Research Station, is the first in this country to have under one roof complete equipment for the acoustical analysis of materials and products of all kinds, from simple domestic appliances to the most complex electronic devices.

Research into noise is being conducted by many organisations. We recently had an opportunity to get first-hand information on some of this work during a visit to the British Internal Combustion Engine Research Association at Slough, where experiments are under way on engine exhaust noise. The character and loudness of the noise from such a system depend on the pressure changes that occur in it, and these in turn depend on the pressure waves and the design inside the system. Typical diesel noise has strong components in the range 800 to 2,000 cycles a second, and in one test at BICERA the resonance of a cast aluminium valve-gear cover was reduced just by changing the position of the holding-down studs. The effect of changing to a steel cover (which produced a new peak in the noise spectrum) and to a plastics cover (which showed no marked resonance) has been investigated as well. Two methods of reducing exhaust noise have been developed. In one, projections on the exhaust valve divide the gas flow into several streams, as a result of which the overall noise level at the open end of the exhaust pipe is reduced by 12 decibels. In the other method, a simple capacity chamber is used in place of the usual manifold. Together these give an overall noise level reduction of 22 decibels. These two examples show the awareness of BICERA to the noise problem and the sort of investigations they are likely to be making in the future.

Aircraft jet noise suppression is receiving considerable attention. The Rolls-Royce units developed for the Avon engines in the Comet, and for the Conway engines in the Boeing 707, reduce the noise level to that of contemporary long-range piston-engined liners. Jet-engine noise is caused by the turbulence that results when the jet exhaust mixes with the atmosphere. This turbulence increases with the speed of the exhaust until mixing is complete. The noise can be cut down if the mixing rate is accelerated and the speed of the jet relative to the atmosphere reduced as quickly as possible. The method Rolls-Royce have adopted to cut down the noise is to use a corrugated nozzle and stimulate the mixing still further by admitting a secondary flow of air through these corrugations. Like so many design problems, the solution is a compromise; it gives reasonable noise reduction without too much loss in thrust or gain in weight. No doubt a better solution will be found as the result of future research.

The Motor Industry Research Association, aided by a grant from DSIR, is carrying out research to reduce the exhaust noise of motor cars and cycles, from the point of view of both driver and onlooker, and have developed test methods for use by industry. So successful some years ago was the Velocette motorcycle designed expressly to cut down noise, that it became known as the "silent" model and, rather like boys in Victorian times, it is seen but not heard.

Other research is going on at the National Engineering Laboratory, near Glasgow, on liquid-borne noise transmitted through oil pipes, and on methods of reducing the noise of machines. The National Physical Laboratory undertake noise surveys for industrial firms and will advise on the best treatment to reduce noise inside (or outside) offices, factories and other places. The Building Research Station are conducting surveys on factory design and the effect of factory noise on neighbouring areas, while the Medical Research Council are studying industrial noise and its effect on hearing.

We might well ask where this trend toward noise abatement is leading us, with its noiseless typewriter, silent motorcycle, soundproof walls and acoustic ceilings. While admitting that soundproofing within reason is most necessary, it will be a dull world indeed when a man has to sing in his tub in an anechoic bathroom and billiard balls no longer have any click.

Cover Picture.—*Fuel elements for Harwell's* PLUTO *are moved between the reactor and the storage block in the 23 ton flask shown in the picture.*

(*Nurnberg photograph for* ENGINEERING)

Plain Words

There is a passage in *King Lear* that always catches my imagination. Kent, banished unjustly, returns to Lear's court in disguise.

On being asked his business, he replies simply: " Service." The King inquires as to whom he would serve; Kent answers " You." The King continues: " Dost thou know me, fellow?" Kent dissimulates: " No, sir; but you have that in your countenance which I would fain call master." To Lear's next question, " What's that?" he replies in one word: "Authority."

I regret that the authority to which we pay respect today is of a different kind, a second-hand authority, borrowed from special and exclusive knowledge. Often it is counterfeit, yet, lacking the same knowledge, we have no means to test it.

We accept too readily the views of physicists on physics, doctors on medicine, soldiers on warfare, economists on economics, and politicians on everything. We even allow them to pontificate on issues only loosely associated with their speciality, and take their words on trust. Whereas the specialist may know the shortcomings of his case, we do not, and if he cares to hide his own misgivings, he can easily convince us. We have only one defence: to ask, as children do, for further explanation, for reasons, reiterating at every step the questions: Why? or How?

Take atom bombs and aberrations in the weather. No self-respecting man would dare to recognise any such connection. Old ladies, intuitive but ill-informed, may blame unusual weather on bombs and rockets, but we who read the serious daily papers and recognise the scientific priesthood must show our understanding by a parrot scepticism—though understanding nothing. A few select statistics from a meteorologist and we haste to join the scoffers.

But after watching a research worker fit a curve to his experimental results, I am convinced that special pleading isn't restricted to old ladies. Scientific authority can be a form of lifemanship, used to back one's personal opinions.

What we really need is a return to the principle of systematic doubt—doubting the scientists in their turn as they once doubted theologians. Even great scientists are not infallible. Lord Rutherford once remarked that we had as much hope of extracting useful power from nuclear reactions as of hitting a fly loose in the Albert Hall with the aid of a peashooter.

Perhaps I'm suffering from sour grapes. My own authority as a specialist is so quickly undermined. " So you're an engineer; I wonder if you'd fix my television set?" Who would trust a man who cannot revive a simple cathode tube on more complicated matters such as spaceflight and melting the Antarctic?

CAPRICORN

Weekly Survey

A Short Sighted Policy

Engineering graduates from Commonwealth countries frequently have to leave Britain after qualifying at universities here and take jobs in Western Germany, Holland and America in order to obtain practical experience.

Some British engineering employers are understood to be reluctant to take these graduates because they fear possible difficulties when they are sent to works or sites. A second reason that has been advanced is that after, to take a case, a Ghanaian engineer has worked for two or three years with a British company he may return to his country leaving the total number of British engineers one less, compared with the loss of a British engineer whose move is part of a theoretical chain which in the end would bring another man back to the firm.

Mr. A. McDonald, secretary of the Institution of Civil Engineers, who has just returned to London with Professor A. J. S. Pippard, F.R.S., President of the Institution, from a tour of West Africa commented on this situation to ENGINEERING. Such an attitude is plainly short sighted, said Mr. McDonald. When these engineers go back to their own homes they will take with them a goodwill towards the countries that gave them the chance to practise. This can be of serious consequence in terms of trade developments.

Mr. McDonald stressed that some British firms are doing valuable work in taking graduate West African engineers on to their staff. There are certainly a number of firms who take this really seriously, he said. Of course it is perhaps easier for, say, a large constructional company with works going on overseas.

Professor Pippard and Mr. McDonald were away for a month visiting the Joint Groups of the Civils, Mechanicals and Electricals in Ghana and Nigeria. Among their conversations with leading figures was one of 45 minutes with Dr. Kwame Nkrumah, prime minister of Ghana, who showed the closest interest in problems of organisational structure for the universities of his country.

Of the intense competition from German, Dutch, American and Israeli engineering interests met in the developing West African nations, Mr. McDonald mentioned the powerful consortium of Dutch consulting engineers, NEDECO. Some idea of the service this group can give may be obtained from the comparison that to equal its ability to put the right expert in the right place a British firm would need to be able to borrow a man of the authority and standing of the chief or deputy engineer of a great port, possibly for months.

The visitors from the senior Institution found that other engineers than the British alone were actively interested in the joint groups. Some thought is going on in London on what may be done to give some more right than that of a guest in the affairs of the joint groups to professional engineers who are not members of one of the senior Institutions.

There is already existing in Nigeria a national society of engineers. Mr. McDonald recalls three years ago addressing the founding meeting of such a society in London, being then assured it was intended only for the students in London.

The difficult question of standards is involved here. While many of the most influential people are determined that the standards of university teaching shall be maintained, there are others who would be prepared to lower standards in order to increase numbers.

As yet there are not the grammar schools to provide all the students the colleges could take but work on this is going on and such new countries could not be expected to build an education system entire in a few years. There is a similar shortage at one stage below that of the professional engineer. There are not enough sub-professional people for all the work going forward and too much time tends to be spent by qualified engineers on routine tasks.

Lord Hailsham Expects

From a platform in the Cabinet Offices Lord Hailsham, Minister for Science, has explained at length the things he does not propose to do. They varied from not being an overlord to a number of ministries, whose own ministers had probably never heard of the idea until the newly named minister generously declared against it, to not flinging clutches of satellites into orbit, a singularly easy thing to refrain from in our present situation.

On the positive side Lord Hailsham gave an example of the ease with which the super sophisticated politician can handle a controversial point. Some concern has inevitably been expressed that this appointment may lead to quick returns being sought, with detrimental effects in the long term. The Minister of Science spoke instead of encouraging the growing points, which sounds unexceptionable until a moment's thought is given to the wealth of corridor conniving and skilled public relations that can go into promoting one growing point against another.

Explaining that his powers were not legally greater than in his Lord President days, Lord Hailsham said he could only obtain the promotion of Science by the arts of encouragement, diplomacy, enthusiasm, example, precept and advice.

Enigmatically he suggested that government science, perhaps all British science, is too parochially minded, too departmentalised and lacking in broader vision. It will be interesting to discover from the Minister's next speech what particularly he has in mind.

All those colleges that do not happen to stand near the Isis or the Cam may well be pleased at one of Lord Hailsham's later sallies. Singing the old song about the need for industry and industrialists to open the purse strings for the universities, he put sting in the tail by failing to see why such gifts should be confined to Oxford, Cambridge and London.

All Burned Up

The Combustion Engineering Association conference on automatic control of solid fuel using boiler plant opens at Scarborough (November 3-4) with the air cleared by the general election and the knowledge that fuel users may go their own way uninfluenced by a government policy of compulsion in the use of coal.

In a time of shrinking profit margins, any cost factor that can be trimmed is due for examination and the fuel experts are in no doubt that greater efficiency can in many cases be achieved in the use of fuels. This is particularly the case where coal has been burned by some industries for their whole history, sometimes in plant of disreputable antiquity.

The National Coal Board has considerable, and reasonable, hopes of making a good showing in the fight with other fuels by spreading the gospel of better boiler equipment and the most accurate selection possible of the various types of coal available.

The Coal Board's soft but effective voice on this occasion will be that of Mr. R. H. E. Thomas, the marketing member of the Board. The Combustion Engineering Association's president, Mr. Paul Chambers, future chairman of Imperial Chemical Industries, in introducing the

conference has emphasised that industrial policy is now governed by cost and production efficiency, not forgetting the Clean Air Act, and no longer by questions of fuel availability.

The Coal Board is making special efforts to provide the types of coal most suitable for the critical conditions of modern plant. They are also in the early stages of their winter campaign to make it known in industry just how wide is the range of coal available, and, highly relevant to the cost, that there is more than one way in which the coal can be brought from the pit to the plant.

BOAC Doing Better

British Overseas Airways, losing £5,179,420 last year, more than £3 million being a deficit of the associated companies, may break even this year, in the opinion of the part-time chairman, Sir Gerard d'Erlanger.

Why so violent a swing of the pendulum? The answer takes in everything from labour relations to a five-year old echo of the Comet disasters. In between is the effect on last year's figures of the recession, of the cost of introducing new fleets, and on the credit side, buoying up hopes for this year, the success of the Comet IV, dramatic reductions in engineering costs, and the absence (so far) of a commercially costly affair like the revolt in the Lebanon.

Labour relations first. Their collapse at London Airport and the bitterly contested strike in the engineering department of October last year cost the corporation at least £1,250,000 and some undesirable publicity. The echo of the Comet tragedies comes with the disposal, at a loss of £1,123,069, of the secondhand aircraft bought at inflated prices when the Comet I's were withdrawn from service in 1954.

The Corporation makes a point on the expense of introducing British-built aircraft to service that ought to receive serious consideration. £5,000,000 was written off against the cost of getting the Britannia's and Comets into fare producing use. This, they say, ought to be charged against the government's funds for research and development.

The Corporation, a useful dollar earner is, and presumably could continue, buying American built aircraft in purchases running into the £10,000,000's. If the Corporation can get its teething troubles worked out by the mighty American air industry and then come in as a customer, avoiding development costs which in this account almost equal the whole immense loss, then the temptation to " buy American "—or if it were not for spares problems even Russian one day—may prove overwhelming.

The extent of the reorganisation in the engineering department, reduced in strength by 1,100 in the past two years, is indicated by the drop in the department's cost per capacity ton-mile from 10½*d* in 1957-58 to 7*d* in 1959-60, and the expected 5½*d* in 1960-61. Since this will in practice simply bring BOAC to a competitive position in relation to other airlines it is more an indictment of the state of affairs in earlier years than of special ability now. Against that can be set the achievement that while the average increase in traffic revenue for all major airlines last year over the year before was 5 per cent, for BOAC it was 9 per cent.

Using the Expert

Mr. Robert L. Garner, president of the International Finance Corporation, has commented on the importance of using the professional services of engineers and other experts in development projects. In the course of his address at the IFC's annual meeting in Washington he said that the corporation had been pleased to note the increasing number of international professional firms which were expanding their operations in the developing areas, sometimes in association with local firms and generally using available qualified local personnel.

He has noticed a reluctance in some cases to use professional advice. Although this stricture applies mainly to an unwillingness to use accountants, it is possible to see in his remarks a general reluctance in some localities to understand the function of professional advice. The idea dies hard in some places that professional people are brought in to snoop and to criticise the efforts of local people who have to put together plans with limited experience, slender resources and conflicting as well as vociferous claimants for help under the development plans. The fact needs wider acceptance that professional people are available to give management (itself a precious and insufficiently prized commodity in some places) the best and latest technical advice, a check on local estimates and plans and an often-needed injection of reality into schemes which have become blown up by local optimism as a result of living too long with the problem.

Motorway and Safety

By the time next year's Motor Show comes round the Midlands motorist will be able to approach London very much more quickly, using the new London-Birmingham motorway. And with the present gradual deceleration of London traffic, approaching is about all he will be able to do.

Highly relevant to the traffic problem of our big cities, because of their common sense and immediate possibility, are the six points made by the London and Home Counties traffic advisory committee in their 33rd report.

These, on the principles which should govern the planning and control of the London road system in the next few years, are briefly:

Physical improvements to the whole London road system with all speed.

Full traffic engineering review of key intersections to " tune-up " the road system by better signals, lane markings, kerb signs and amended traffic routeing.

Comprehensive schemes for parking control in central London and adequate parking, waiting and loading facilities in developments.

Positive segregation of pedestrians and traffic to be actively carried out in the replanning of urban areas, the segregation to be either lateral or by different levels. More frequent use of pedestrian bridges, subways and guard rails.

The stricter enforcement of pedestrian and driver regulations and the achievement of better discipline.

The training of an adequate engineering staff in order to bring the first five of these into effect.

The opening of the new motorway has been the occasion of the release by Shell-Mex and BP of five specially made " filmlets " dealing with safety on the special roads. The five are on parking, drowsiness, lane discipline, turning and hard shoulders. The name Shell is for many television viewers, and these filmlets will appear on the small screen and elsewhere, associated with pleasing and civilised programmes. The tradition is being here maintained as the great oil concern focuses attention on one of the inescapable, but still tragic, side effects of progress.

At the same time Shell is making available to schools special road safety kits, involving jig saws large enough to be made up by groups of children. Evidently a serious contribution to the planning of these kits has been made from educational experience. Illustrative of particular road and kerb side dangers, each puzzle demands from its compilers discussion on the choice of alternative titles, which form the last piece, and movement around the classroom to obtain the chosen wording.

The filmlets, for 16 mm and 35 mm, can be borrowed free from Shell-Mex and BP, Shell-Mex House, Strand, London, WC2.

The schools jig saws from the Public Relations Department at the same address.

The report, *London Traffic 1948*, is available, price 4s 6d, from the Stationery Office.

Letters to the Editor

ENGINEERS' EARNINGS

SIR, Your article " What Engineers Earn—First Full Survey " (ENGNG., 16 Oct., p. 341) confirms my knowledge of the facts and my belief that the position is largely brought about by the absence of genuine competition for engineers between large firms; the tendency to create associations of firms into groups still further reduces such competition.

Most young men who wish to enter the engineering industry generally join a large firm because it has the facilities and programmes to give them the training and experience they require. Such firms willingly provide this training and experience, secure in the knowledge that when the young man matures, most avenues of escape to a better position and salary are blocked by an agreement (probably unwritten) between large firms not to take each other's engineers. Research into the " Personal " pages of engineering journals shows the almost complete lack of movement of engineers between the large firms.

The foregoing is based upon experience in the electrical industry, but no doubt the same policy operates in other sections of the engineering industry. I have reached an age and position where salary no longer worries me. I write only in the interest of my country's future which is inevitably tied to the status of her engineers and their achievements.

For professional reasons I must ask you not to publish my name and address and to allow me to conclude,

Yours faithfully,
Chartered Electrical Engineer.

AUTOMOBILE ASYMPTOTE

SIR, May I refer to your leader on the Motor Show (ENGNG., 16 Oct. '59, p. 333)? It seems to me to be a very excellent leader, and raises a number of points with which I agree.

Particularly it seems to me strange that car manufacturers do not realise that there are best ways of doing each particular job and that unfortunately, no one car as yet combines all of these. You mention the question of chassis lubrication. If one car can do without it, surely all the others can!

The trend, which you mention, towards such specialisation that ordinary garage mechanics cannot repair anything but merely send it back for replacement is, I am afraid, already with us. I notice that you also mention the question of styling. I suppose it is too much to hope that people will be contented with a decent, reasonably roomy car and not continually be slaves to fashion.

Finally, I hope some notice may be taken of your last paragraph pointing out our lack of roads. This crystal ball stuff is always somewhat intriguing but it is liable to catch up with you later.

Yours sincerely,
J. S. BLAIR.

3 East Carlton Park,
Market Harborough, Leicestershire.
23 October, 1959.

BRITAIN'S WATERWAYS

SIR, In your issue of 23 October (p. 390), you published an article under the heading Design dealing with the new Massey-Ferguson power shovel.

In a description of the equipment's capabilities you mention that it " excels in digging, dredging and clearing irrigation canals and ditches." Yet the photograph you print, presumably as a demonstration of its prowess at this job, is actually of the clearing and restoration of the first piece of *navigation* canal to be put back into use in this country during this century.

In view of the growing realisation throughout the country that in our present state of transport

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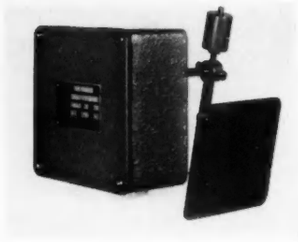
AIR FLOW SWITCH

Safety Control



A range of switches actuated by air flow is now available for use in safety and control circuits.

The switches operate by means of a balanced vane on which the passing air or gas impinges. There are several models so that they can be installed in various positions and in streams of different rate. The one illustrated is the AS which is suitable for velocities up to 300 ft per minute. It has a single-pole changeover snap-action switch rated at 2A 440V a.c. which can be arranged to give the required switching action. The vane measures 3¼ in by 3½ in.

Model AFS is housed in a welded steel case. The vane assembly consists of the air vane and its counterbalance and is mounted on a stainless-steel shaft. This shaft is supported internally by two ball bearings and carries a mercury switch of special design which does not affect the dynamic balance. The counterbalance allows the vane assembly to be positioned on site to suit the airflow without altering the sensitivity of the unit. The mercury switch is rated at 1A at 250V and can be replaced by a snap switch rated at 2A. It is suitable for velocities up to 275 ft per minute.

For flows up to 150 ft per minute type AFS/150 can be used. This is similar to the previous model but has a larger vane area. Type AFS/FP is a flame proof version covered by Buxton certificates for Groups I, II, and III gases. The vane shaft is coupled magnetically to the snap-action switching mechanism, thus avoiding any entry into the flame-proof case for the shaft. *Londex Limited, Anerley Works, 207 Anerley Road, London, SE20.*

HAND DRILL

With Built-in Spirit Level

The Revo Jobber is claimed to be the only electric hand drill that has a built-in spirit level; it also forms the basic power unit for a " home workshop" series of packs.

The drill is fitted with a $\frac{6}{16}$ in chuck and will drill this diameter in steel or up to ¾ in in wood. Running free, the chuck speed is 3,000 r.p.m., falling to about 2,000 r.p.m. at full load. Overall, the drill measures 8 in long and weighs 4½ lb. A feature is the detachable second handle that can be used to keep it steady in operation.

The motor is available for 200-220V or 230-250V a.c. or d.c., and is rated at 350 W. It is of the capsule type. Cooling is obtained by a 24-blade fan mounted on the armature shaft giving the drill continuous rating. Single-reduction helical gears are used running packed in grease. Control is by a trigger switch which can be locked on.

For the home workshop there is a series of 17 packs. Taken singly or in combination, these make up the parts needed for a bench drill, lathe, saw bench, and sanding and polishing sets.

When fitted up as bench drill, the length of stroke possible is 2¾ in. The maximum distance between the chuck axis and the pillar is 3½ in and from chuck to table 25 in. As a lathe, there is 23 in between centres and the centres are 3½ in above the bed, allowing work up to 4 in diameter to be turned. The maximum diameter for faceplate turning is 6 in. The saw blade is 6 in diameter giving a maximum thickness of cut at 90° of $1\frac{9}{16}$ in. The table measures 10 in by 10½ in. *Revo Electric Company Limited, Groveland Road, Tipton, Staffordshire.*

Concluding

Letters to the Editor

chaos we can in no wise permit our inland waterways to remain in their suppressed condition, I am disappointed that you did not take this opportunity of pointing out to your readers a quick and easy modern method of restoring a means of transport acknowledged in every other industrial country as the most economical possible.

As you know from the addresses to the British Association, published in your columns, transport costs one quarter of our total income, and no avenue should remain unexplored in the search for a means of reducing this bill.

I trust that ENGINEERING will take our side in our struggle with that authority which is legally supposed to maintain and improve the waterways, but by reason of its size and wealth appears to be above the law.

I am, Sir,
Your obedient servant,
M. J. MACFARLANE,
Joint Secretary, Midlands Branch.
Inland Waterways Association Limited,
68 Crick Road, Hillmorton, Rugby.
26 October, 1959.

MINIATURE TIMER

Adjustable Intervals

The type AMS synchronous timer is a multiple-circuit multiple-interval instrument with adjustable time settings.

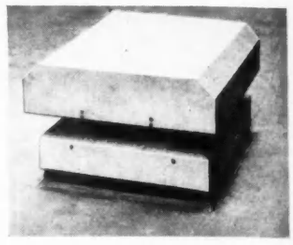
The timer consists essentially of an electromagnetically operated clutch, continuously and independently adjustable calibrated time-setting dials, each associated with a snap-action change-over switch, an adjustable mechanism resetting the timer within a half second, and a miniature synchronous motor.

It is supplied with 1, 2 or 3 changeover switches. Each switch is associated with a continuously adjustable cam which has the effective length of cutout variable by turning the calibrated dials attached to each half cam. On reset all the changeover switches are returned instantly to de-energised position before the switch operating cams are returned automatically to zero position within half a second. If the clutch coil is wired into one of the timed circuits the timer will reset automatically at the point to which this circuit has been preset. When the electromagnetic clutch is connected directly to the voltage supply the timer will repeat its maximum timing cycle continuously with automatic reset on power failure or shut down only.

The unit measures 2¾ in by 3½ in by 6½ in when fitted with two timing cams, and the switching capacity is 10A at 250V a.c. non-inductive load. This reduces to 6A for inductive systems. Units can be supplied for times ranging from 30 sec to 48 hours as standard. Sintered oil-retaining bearings are used at the spindle ends, and ball bearings and a thrust race in the resetting mechanism. *Electrical Remote Control Limited, Elremco Works, Harlow New Town, Essex.*

AIR EXTRACTOR

Roof Ventilation Unit



The Mechavent Roofline is a fan-driven extractor for ventilating buildings.

Eight sizes are available each with more than one fan speed so that there are in all 20 models giving a capacity range from 300 c.f.m. to 19,500 c.f.m. The corresponding motor inputs range from 34W to 1,550W. Flame-proof motors are available.

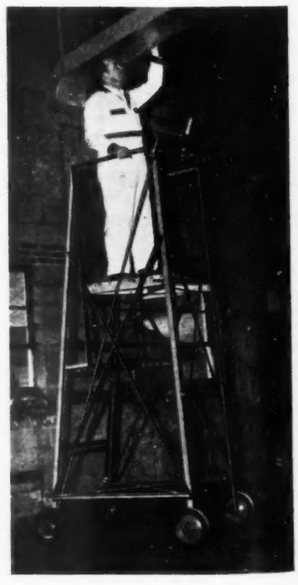
To prevent heat losses when the fan is not running the units can be provided with internal auto shutters. These are easily removable if desired. Where powered intake ventilators are required reversible motors are available, but there will be some loss of efficiency when running reversed. The ventilators can be supplied for mounting on flat or sloping roofs. They are made of heavy-gauge hardened aluminium which is non corrosive and needs no maintenance.

It is claimed that the units are easy to install. The fan and motor are mounted on a heavy gauge diaphragm plate which is fitted to the roof independently of the extractor head and stack. This facilitates handling the unit in two easily manageable parts and is especially useful for installations where the larger sizes are involved.

The extractor head is designed to overlap the stack sufficiently to ensure that the unit is weatherproof under all conditions without causing any restrictions of airflow through the extractor. Grease nipples for lubricating the motor are situated externally on the stack, and no access panels are needed. *Greenwood and Airvac Ventilating Company Limited, Beacon House, Kingsway, London, WC2.*

SELF-PROPELLED STAGING

One Man Control

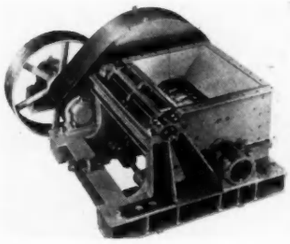


The Move-on staging can be shifted to the required position by the operator without his having to come down to ground level.

By rotating a handle that is situated on the platform rail the operator can move himself backward or forward with equal ease. A second handle works the Ackermann steering gear. The standard frame will pass through any doorway greater than 6 ft 6 in by 2 ft 6 in.

The platform can be set at any one of six different heights from 2 ft to 5 ft above ground level giving a working height of up to about 12 ft. A fixed handrail gives the operator security, and access to the platform is by a series of rungs. The staging runs on rubber-tyred wheels and is fitted with a safety brake which will hold it in position while work is in progress. It is claimed that the unit is very stable and that it will safely carry the heaviest man and his tools. *Anderston Clyde (Midlands) Limited, St. Crispin's Works, Cradock Street, Loughborough.*

ROLL CRUSHER
Capacity up to 500 tons per hour



Now being made under licence in this country is the Pennsylvania Hercules range of roll crushers.

Four sizes are being made with rolls measuring 30 in in diameter and 30in, 40 in, 50 in and 60 in in width. The corresponding maximum sizes of feed are 20 in, 24 in, 30 in and 36 in, and the horse powers of the main driving motors 100, 150, 200 and 250. Capacities when crushing to 5 in range from 200 to 500 tons per hour.

Both the frame of the crusher and the breaker plate have been designed for all welded construction and the whole crushing zone is protected by steel liners. The breaker plate is held in position by means of a spring-loaded holdback bolt in conjunction with two toggles, one on each side of the frame. Each toggle is held in the fully extended position by a torsion spring. This arrangement serves to protect the moving parts against breakage in the event of tramp iron or other uncrushable material getting into the feed. A turnbuckle on the bolt allows adjustments to be made to the breaker plate while the hold-back bolt is locked with a pin. The required number of packing pieces is then inserted.

In the event of tramp iron entering the crushing zone the breaker plate retracts against the torsion springs forcing the toggles upwards and so allows the iron to pass through. The return movement of the plate after the iron has passed is cushioned by a spring.

The toothed crushing roll is driven from the motor through V belts and reduction gears. For a motor running at 700 r.p.m. the roll revolves at 40 r.p.m. *Fraser and Chalmers Engineering Works, Erith, Kent.*

VACUUM REFINER
Includes Degassing Unit

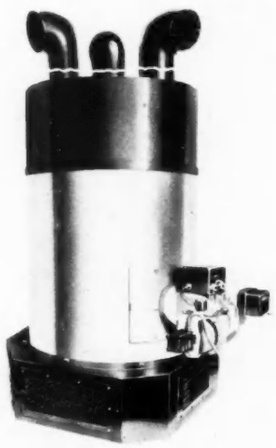
A VACUUM furnace with a built-in degassing unit avoids the difficulties encountered with ladle degassing systems. Turbulence of the molten metal is produced by electromagnetic means.

Basically the equipment consists of a 15 cwt induction-melting furnace working at mains frequency and housed in a tiltable vacuum tank. A water-cooled induction coil which is supported by a magnetically shielded steel framework forms the furnace proper. Mains frequency not only allows more economical running but also imparts greater turbulence to the metal. The 15 cwt unit has a rating of 300 kW and is arranged for connection to a low-tension three-phase supply.

The vacuum tank which houses the furnace is mounted on trunnions and tilted by twin hydraulic cylinders. The tank movement produces an approximately lip axis pouring effect, and a retractable bridge over the top flange of the tank carries the metal stream. Hydraulic controls open and close the vacuum tank lid and pneumatic clamps lock the lid on to the tank. The furnace mount has a refractory cover and the vacuum pumping lines are connected concentrically with the tilting trunnion. Automatic controls allow the equipment to be operated by relatively unskilled personnel.

A typical cycle occupies about one hour, starting with liquid metal brought to the furnace by a ladle. It takes about 15 minutes to reduce the pressure to about 200 to 300 microns after the lid has been clamped. Power is then applied for stirring and to maintain temperature. After treatment, casting or teeming follow the usual pattern. The makers claim that results have shown the furnace to be very accurate and cheap to run. *Birlec-Efco (Melting) Limited, Westgate, Aldridge, Staffordshire.*

AIR HEATER
For Larger Buildings and Factories



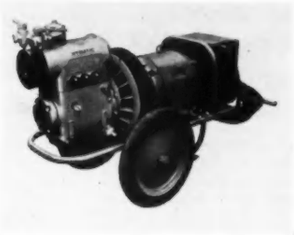
A RANGE of compact oil-fired air heaters has been introduced for heating factories, hangers and the like.

The units are entirely self contained and range in size up to 800,000 Btu per hour. A hot water supply can be obtained by the use of an economiser, and cold air can be circulated in hot weather.

The fan chamber is at the bottom of the unit and the fan is thermostatically controlled. Air is drawn from inside or outside the building and is passed first through an annular space between the refractory-lined combustion chamber and the outer wall. It is then passed to the heat exchanger and so out through the adjustable diffusers into the building.

In the furnace chamber is a shell-type pressure-jet burner. The burnt gases are led through the heat exchanger to the flue stack and escape to atmosphere. Provision for the flue pipe, and connections to the electricity mains and fuel supply are the only requirements for installation. The dimensions of the 500,000 Btu per hour model are: 3 ft 6 in in diameter and 6 ft 11 in in height. *Speedyheat Limited, 44 Tower Hill, London, EC3.*

PORTABLE AIR COMPRESSOR
Electric Drive



A PORTABLE electrically driven air compressor has been introduced primarily for use in the contracting and building industries.

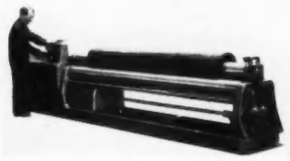
With a free air delivery of 65 c.f.m. at a working pressure of 100 lb per sq. in, the new compressor (known as the 90E100) will operate continuously at full working pressure four pneumatic hand drills of the CP9 type, or two heavy drills, light breakers, demolition picks or clay picks. Alternatively the unit will operate one heavy concrete breaker or a similar large pneumatic tool.

The compressor of the unit is the standard Hymatic Hydrovane oil-sealed rotary design. It is directly driven by a 25 h.p. 3-phase electric motor with a star-delta starter. Built-in equipment includes an air intake filter, automatic pressure control, pressure gauge, and safety valve. The unit is mounted on a tubular frame with large diameter pneumatic tyres so that it can be handled with ease.

The weight of the complete equipment is 707 lb and the overall measurements are 62 in long by 28¼ in wide by 37 in high. These dimensions allow it to be wheeled through a standard size doorway or transported in a hoist to any part of a building site. The frame has been designed for ease of manoeuvering.

It is claimed that the compressor needs very little maintenance and that, due to the oil sealing, the output does not fall off with prolonged use. It is also stated that the absence of fumes and the quiet running allow the compressor to be used close to the operators and thereby avoids the need for long lengths of hose. *Hymatic Engineering Company Limited, Glover Street, Redditch, Worcs.*

PLATE BENDING ROLLERS
Up to $\frac{3}{16}$ in Mild Steel



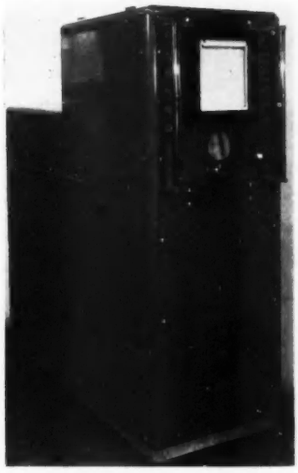
A NEW range of Besco pyramid plate bending rollers, to be known as the model TRP, includes three sizes that will take mild steel sheet up to 6 ft wide by $\frac{3}{8}$ in thick, 8 ft by $\frac{1}{4}$ in, and 10 ft by $\frac{3}{16}$ in.

Power control covers the operations of adjustment to the top pressure roller for various radii, and also the actual feeding of the plates through the rollers. A screw-operated rise and fall self-support to the top pressure roller, around which plates are formed, frees the plate for withdrawal from the machine. The bearing at the opposite end to the support drops downwards, leaving the roller end free for withdrawing complete cylinders.

A pyramid roll formation is used, with the two 7¼ in diameter bottom rollers supported in fixed bearings and at close centres so that the flats at start and finish of the work are reduced to a minimum. The 8¼ in diameter pressure roller is in adjustable bearing blocks.

The top pressure roller is adjustable for various radii through a separate 4 h.p. motor from push buttons on the main control panel. The motor is fitted with a magnetic brake. Limit switches with adjustable stops give precise control to this roller. The main feed roller drive is supported on the base and comprises a 7½ h.p. slipring motor with V link belt drive to the single reduction worm gear unit, and machine cut pinions on the feed roller ends. A magnetic brake prevents overrun. Reverse direction of feed is obtained by a joystick reversing controller on the main control panel. A safety device prevents the machine from running unless the top pressure roller support is released. The overall height is 47 in and the floor space needed is 29 in by 185 in for the largest model in the range. *F. J. Edwards Limited, 359-361 Euston Road, London, NW1.*

BERYLLIUM MONITOR
Alarms Incorporated



A MONITOR has been designed for the Atomic Energy Authority which will make six atmosphere checks per hour for beryllium content.

In operation, 100 litres of air are sampled every 10 or 12 minutes. The range is from 0·25 to 25 "tolerances" (1 tolerance is 2 microgrammes per cubic metre) and the readings are recorded on a moving chart. Audible and visible alarms are incorporated to give warning of dangerous concentrations.

The dust is collected on a continuous strip of filter paper and a disc punched out to fall into a dish. In turn, at separate stations, sulphuric acid is added; heat is applied to dissolve the dust and paper; the solution is cooled and scandium sulphate solution is added; the dish is placed in a spark chamber and, after sparking, is dropped into a waste receptacle.

A new dish and new carbon electrodes are used for each sample, being supplied from magazines of 50 and changed automatically. Fumes are extracted through a filter. The monitor is 20 in wide and mounted on a trolley. *Glass Developments Limited, Sudbourne Road, London, SW2.*

SANDING ATTACHMENT

Ball Joint Drive

A SANDING disc attachment for an electric drill is now made with a ball-joint drive so that the disc will always lie flat on the surface of the work. It is known as the Swirlaway.

It is particularly claimed for the attachment that it will not produce swirls on the finished surface nor will it cut into the work as a result of running away or of not holding the drill vertical. The fact that the disc always remains flat also means that the effective sanding area is kept at the maximum.

The ball joint is housed in Nylon and kept in place by a spring. The joint can be locked and then the sander will be held rigid as in conventional types. It is also claimed that a finer finish can be obtained. The pack consists of the ball-joint attachment, a lambswool polishing bonnet and three aluminium oxide sanding discs. Replacement discs are available in several grades, and silicon carbide discs are made for metal working. Discs can be cleaned when clogged by running

them against a piece of foam rubber. *Stanley Works (G.B.) Limited, Rutland Road, Sheffield 3.*

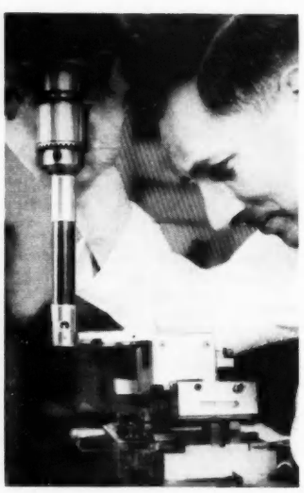
EDGE LOCATOR

For Setting-Up Work

THE Apwar Edgefinder is intended to locate very exactly the edge of a work piece on a machine tool in relation to the centre line of the spindle.

The tool has a ⅜ in diameter parallel shank by which it is held in the chuck; when not in use, the shank is protected by a spring-loaded shield. The locating section consists of a cylinder from which project four small contacts set at 90° around the circumference, and within which is a light bulb. When any one of the contacts touches the work piece two of the four corresponding windows are illuminated by the bulb. Power to light the bulb is supplied by a pencil torch battery contained in the body of the tool.

The tool is mounted in the chuck and then rotated by hand; at the same time the work piece is advanced until contact is made as indicated by the light. It is claimed that the location is to within 0·0002 in and that, within reason, it is not necessary for the chuck to run absolutely true. The tool is said to be particularly useful when the control handle



is a long way from the spindle of the machine. *A. P. Warren Limited, 37 Sheen Road, Richmond, Surrey.*

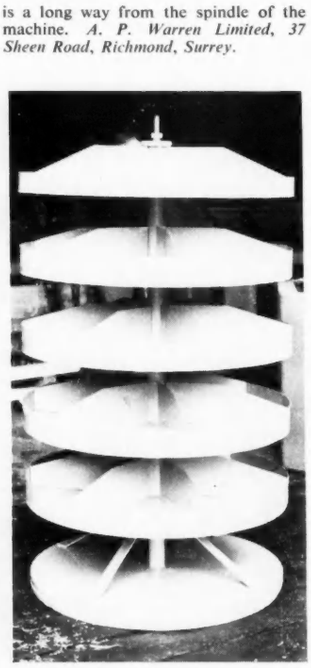
STORAGE RACKS

Rotating Component Trays

THE RovaBin is a form of storage rack that makes available a wide choice of components to an operator placed at one point.

Essentially, it consists of a series of trays mounted on a central column, with each tray divided into six equal size compartments. The base can be fixed to the floor if desired. The tray mountings are fitted with ball bearings so that they can revolve freely and independantly on the centre column and any required division can be reached with a minimum of trouble.

The illustration shows the largest size made, having five trays. Models with fewer are available. The overall dimensions are 64 in high and the trays are 35½ in in diameter. Each tray can take a load of 2 cwt. so that the whole is capable of carrying ½ ton. On an assembly line it would allow one man to have up to 30 components within reach without moving. *W. Pinder and Son Limited, King Street, Peterborough.*



LABEL MARKER

Embossed White Figures

THE Dymo-mite is a hand-operated machine that will produce embossed white lettering on ½ in wide tape for labels or marking tags.

In operation a roll of tape is loaded into the magazine in the handle of the tool and threaded through the embossing head. The engraved plate is turned to the letter or number required and the handles closed. It is said that only a light grip is needed. Each closure of the handles moves the tape forward one space ready for the next impression. Spaces between letters are obtained by half closing the handles. At the front of the tool is a cut-off blade which will sever the completed tape at the pressure of a thumb. This device avoids the need for an independent separating tool.

Tapes for embossing are available in clear, blue, green, red or brown vinyl, or in aluminium. The rolls are 12 ft long and ½ in wide. All those mentioned are supplied with adhesive backs protected by a backing strip, but tapes without adhesive are available in alu-

minium, vinyl, monel, stainless steel, copper, and zinc. *Hellermann Limited, Crawley, Sussex.*

STROBOSCOPE

Portable and Battery Operated

THE Stropack type 1211 is a battery operated stroboscope which is completely portable.

Power is supplied by any battery capable of producing 1A at 12V. The one shown in the carrying case weighs 9¾ lb and measures 9½ in by 5½ in by 4 in. It will give 8 hours operation.

A pulse output is produced from the d.c. source by a multi-vibrator circuit, the repetition rate being controlled by a potentiometer through a slow motion drive. After differentiation and amplification the output from the multi-vibrator circuit is fed to a step-up transformer to provide the high-voltage pulse to trigger the flash tube. The neon filled tube has a flash duration of 15 microseconds.

The output from the multi-vibrator also operates a frequency meter circuit, the meter being calibrated directly in r.p.m. Flash rates between 600 and 15,000 r.p.m. are covered in two ranges. The accuracy is ± 2 per cent of full scale. The Stropack measures 5¼ in

by 3½ in by 7⅞ in and weighs 3¾ lb. *Dawe Instruments Limited, 99 Uxbridge Road, London, W5.*

MOBILE STEPS

With Elevating Shelf

A SPECIAL model that has now been added to the standard range of Mountie safety steps and ladders incorporates an elevating shelf which will lift 250 lb.

The shelf is on rollers that run along bars on the main frame of the steps and travels from almost ground level to the top of the hand rail. It is raised and lowered by a self-sustaining winch operated from ground level. One of the advantages claimed for having a front shelf is that, with one operator only, goods can be on and off loaded at the required height from either side.

Models with the elevating shelf can be supplied with from 8 to 12 steps. They are fitted with the standard Tread-lock anchorage which prevents the steps from moving when in use. The width at the base of all models is 2 ft 6 in. They are said to be particularly useful for stores and stock rooms where high shelves and racks contain fairly heavy parts. *Access Equipment Limited, Maylands Avenue, Hemel Hempstead, Herts.*

This list, in chronological order, appears in the last issue of each month. Events noticed for the first time and alterations of dates, places, etc., are indicated by an asterisk(*). For details of events not included below, reference should be made to ENGINEERING, *28 August, page 100, and 25 September, page 243. Organisers are invited to send particulars of coming events to the Editor.*

***British Design in Denmark, Exhibition.**—During November, at the Kunstindustrimuseet (museum of Decorative Art), Copenhagen. Sponsored by the British Import Union of Denmark, the Danish-British Society, and the Council of Industrial Design. Apply to the Council of Industrial Design, 28 Haymarket, London, SW1. Tel. TRAfalgar 8000.

American Concrete Institute, Regional Meeting.—Mon., 2 Nov., to Thurs., 5 Nov., in Mexico City. Theme: "Concrete Problems and Techniques in Mexico and the South Western United States." Institute offices: P.O. Box 4754, Redford Station, Detroit 19, Mich., USA.

Combustion Institute, Fall Meeting.—Mon., 2 Nov., to Thurs., 5 Nov., in Los Angeles. Theme: "Equilibria and Performance of High-Temperature Systems, with Particular Reference to Rocket, Ramjet and Turbojet Systems." Apply to the secretary, Western States Section, Combustion Institute, 16902 Bollinger Drive, Pacific Palisades, Calif., USA.

Combustion Engineering Association.—Tues., and Wed., 3 and 4 Nov., at the Royal Hotel, Scarborough. Association's offices: 70 Jermyn Street, London, SW1. Tel. WHItehall 5536.

Canadian National Packaging Exhibition.—Tues., 3 Nov., to Thurs., 5 Nov., in the Automotive Building, Exhibition Grounds, Toronto. Sponsored by the Packaging Association of Canada, 1 St. Claire Avenue W., Toronto 7, Canada.

***Institute of Welding, Autumn Meeting.**—Tues., 3 Nov., to Fri., 6 Nov., in London. Joint meeting with the French Society of Welding Engineers. Reception on 3 Nov. at 54 Princes Gate and annual dinner on 4 Nov. at the Park Lane Hotel. Offices of the Institute: 54 Princes Gate, Exhibition Road, London, SW7. Tel. KNIghtsbridge 8556.

Industrial Efficiency and Safety Exhibition.—Tues., 3 Nov., to Sat., 14 Nov., at the City Hall, Deansgate, Manchester 3. Organised by Provincial Exhibitions, Ltd., City Hall, Deansgate, Manchester. Tel. Deansgate 6363.

***Institution of Industrial Safety Officers, Annual Conference.**—Fri., 6 Nov., to Sun, 8 Nov., at the Grand Hotel, Brighton. Institution's offices: Terminal House, 52 Grosvenor Gardens, London, SW1. Tel. SLOane 2246.

***British Sports Trade Fair.**—Mon., 9 Nov., to Fri., 13 Nov., at Berners Hotel, Berners Street, London, W1. Organised by the Federation of British Manufacturers of Sports and Games Ltd., 25 Haymarket, London, SW1. Tel. WHItehall 5845.

ELECTRICAL TECHNIQUES

Electrical Techniques in Medicine and Biology.—Tues., 10 Nov., to Thurs., 12 Nov., in the Sheraton Hotel, Philadelphia, Pa., USA. Organised with the approval of the American Institute of Electrical Engineers, the Instrument Society of America, and the Institute of Radio Engineers. Offices of the Institute of Radio Engineers: 1 East 79 Street, New York 21, USA.

Laboratory, Measurement and Automation Techniques in Chemistry, International Congress and Exhibition on (ILMAC).—Tues., 10 Nov. to Sun., 15 Nov., at Basle. Exhibition is being organised by the Swiss Industries Fair at their halls at Basle, and application should be made to the Fair authorities. The conference is being organised jointly by the Swiss Association of Automation and the Association of Swiss Chemists, also in the Fair's hall. Apply to ILMAC, 61 Clarastrasse, Basle, Switzerland.

***Society of Naval Architects and Marine Engineers, 67th Annual Meeting.**—Wed., 11 Nov., to Sat., 14 Nov., at the Waldorf-Astoria Hotel, New York. Society's offices: 74 Trinity Place, New York 6, USA.

***Institute of Sheet Metal Engineering, Annual Autumn Conference and Exhibition.**—Wed. and Thurs., 11 and 12 Nov., at the Charing Cross Hotel, Strand, London, WC2. Institute's offices: John Adam House, Adelphi, London, WC2. Tel. TRAfalgar 6171.

***Thin-Film Techniques Applied to the Electron-Microscopic Examination of Metals, Symposium.**—Thurs., 12 Nov., at the Royal Institution, Albemarle Street, London, W1. Organised by the Metals Physics Committee, Institute of Metals, 17 Belgrave Square, London, SW1. Tel. BELgravia 3291.

***Scottish Motor Exhibition, 42nd.**—Fri., 13 Nov., to Sat., 21 Nov., at Kelvin Hall, Glasgow. Organised by the Scottish Motor Trade Association, Ltd., 3 Palmerston Place, Edinburgh 12. Tel. Edinburgh Caledonian 3643.

Automation Congress and Exposition, Fifth International; and Second Military Automation Show.—Mon., 16 Nov., to Fri., 20 Nov., at the New York Trade Show Building, New York. Organised by Richard Rimbach Associates, 845 Ridge Avenue, Pittsburgh 12, Pa., USA.

***Packaging Machinery Manufacturers Institute Show.**—Tues., 17 Nov., to Fri., 20 Nov., at the Coliseum, New York. Apply to Hanson and Shea, Inc., 1 Gateway Center, Pittsburgh 22, Pa., USA.

***British Institute of Management, 14th National Conference.**—Tues., 17 Nov., to Thurs., 19 Nov., at Harrogate. Offices of the Institute: 80 Fetter Lane, London, EC4. Tel. HOLborn 3456.

Building Exhibition, 28th.—Wed., 18 Nov., to Wed., 2 Dec., at Olympia, London, W14. Offices: 11 Manchester Square, London, W1. Tel. HUNter 1951.

Influence of Plastics in Building, Conference.—Thurs., and Fri., 19 and 20 Nov., at the Royal Institute of British Architects, Portland Place, London, W1. Organised by the Plastics Institute, 6 Mandeville Place, London, W1. Tel. WELbeck 5439.

***Education for Productivity, Conference.**—Fri., 20 Nov., at 21 Tothill Street, London, SW1. Organised by the Central London Productivity Association. Apply to Mr. D. E. Greene, Department of Production Technology, Northampton College, St. John Street, London, EC1.

Radio Hobbies Exhibition, International.—Wed., 25 Nov., to Sat., 28 Nov., at the Royal Horticultural Society's Old Hall, Vincent Square, London, SW1. Held under the auspices of the Radio Society of Great Britain. Exhibition manager: Mr. P. A. Thorogood, 35 Gibbs Avenue, Edgware, Middlesex. Tel. MUSeum 3450.

CORROSION PROBLEMS

Corrosion Problems of the Petroleum Industry, Symposium.—Thurs. and Fri., 26 and 27 Nov., at 21 Tothill Street, London, SW1. Arranged jointly by the Institute of Petroleum, 61 New Cavendish Street, London, W1 (Tel. LANgham 3583); and the Society of Chemical Industry, 14 Belgrave Square, London, SW1. Tel. BELgravia 3681.

***Boat Exposition, First Annual National.**—Fri., 27 Nov., to Sun., 6 Dec., at the Armory, Seattle. Organised by Northwest Marine Industries Inc., Marine Mart, 1500 Westlake Avenue, N., Seattle, Wash., USA.

Chemical Industries Exposition, 27th.—Mon., 30 Nov., to Fri., 4 Dec., at New York Coliseum, New York. Organised by the International Exposition Co., 480 Lexington Avenue, New York 17, USA.

Iron and Steel Institute, Autumn Meeting.—Wed., 2 Dec., to Fri., 4 Dec., in London. Institute's offices: 4 Grosvenor Gardens, London, SW1. Tel. SLOane 0061.

Institute of Marine Engineers, Conversazione.—Fri., 4 Dec., at Grosvenor House, London, W1. Institute's offices: Memorial Building, 76 Mark Lane, London, EC3. Tel. ROYal 8493.

Supervisors in Industry, Residential Course for.—Sat., 5 Dec., to Sat., 12 Dec., at Madingley Hall Cambridge. Apply to Mr. F. V. H. Ramsbottom, Board of Extra-Mural Studies, University of Cambridge, Stuart House, Cambridge. Tel. Cambridge 56275.

***Display and Screen Printing Exhibition, Third.**—Mon., 7 Dec., to Thurs., 10 Dec., at the Washington Hotel, 6 Curzon Street, London, W1. Organised by the Display Producers and Screen Printers Association, 28 Ely Place, London, EC1. Tel. HOLborn 1746.

***Smithfield Show and Agricultural Machinery Exhibition.**—Mon., 7 Dec., to Fri., 11 Dec., at Earl's Court, London, SW5. Apply to the exhibition manager, Smithfield Show Joint Committee, Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

EARTHQUAKES

***Studies in Seismic Engineering, Conference and Exhibition.**—Thurs., 10 Dec., to Sun., 13 Dec., at Messina, to mark 50th anniversary of the Messina earthquake. Conference offices: Palazzo Zanca, Messina, Sicily.

***World Agriculture Fair, First.**—Fri., 11 Dec., to Sun., 14 Feb., 1960, in New Delhi. Offices: Exhibition Grounds, Mathura Road, New Delhi.

Boat Show, Sixth National.—Wed., 30 Dec., to Sat., 9 Jan., 1960, at Earl's Court, London, SW5. Organised by the Ship and Boat Builders' National Federation, 23 Knightsbridge, London, SW1. Tel. BELgravia 6402.

"Model Engineer" Exhibition.—Wed., 30 Dec., to Sat., 9 Jan., 1960, at the Royal Horticultural Society's new hall, Greycoat Street, London, SW1. Organised by The Model Engineer (Percival Marshall and Co., Ltd.), 19-20 Noel Street, London, W1. Tel. GERrard 8811.

***Camping and Outdoor Life Exhibition.**—Sat., 2 Jan., to Sat., 9 Jan., 1960, at Olympia, London, W14. Organised by New Homes and Trades Exhibitions, Ltd., Exhibition House, Spring Street, London, W2. Tel. AMBassador 5421.

Recent Mechanical Engineering Developments in Automatic Control, Symposium.—Tues., 5 Jan., to Thurs., 7 Jan., 1960, at 1 Birdcage Walk, London, SW1. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

***Toy Fair, 11th International.**—Sat., 9 Jan., to Fri., 15 Jan., 1960, at Harrogate. Organised by Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Electronics, Sixth National Symposium on Reliability and Quality Control in.—Mon., 11 Jan., to Wed., 13 Jan., 1960, at the Statler Hilton Hotel, Washington, DC, USA. Information obtainable from Mr. R. Brewer, Research Laboratories, General Electric Co., Ltd., Wembley, Middlesex. Tel. Arnold 1262.

***Physical Society's Exhibition of Scientific Instruments and Apparatus.**—Mon., 11 Jan., to Fri., 22 Jan., 1960, at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

***Hotel and Catering Exhibition, International.**—Tues., 19 Jan., to Thurs., 28 Jan., 1960, at Olympia, London, W14. Organised by the Hotel and Catering Exhibition (London) Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

CLEANING AND MAINTENANCE

Cleaning and Maintenance and Floor Trades Exhibition and Convention, First.—Mon., 1 Feb., to Fri., 5 Feb., 1960, Royal Horticultural Society's old hall, Vincent Square, London, SW1. Organised by Contemporary Exhibitions Ltd., 40 Gerrard Street, London, W1. Tel. GERrard 4951.

***Amusement Trades Exhibition, 16th.**—Tues., 2 Feb., to Thurs., 4 Feb., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Amusement Trades Exhibition Ltd., 19 Charing Cross Road, London, WC2. Tel. WHItehall 2524.

***Stationery Trades Exhibition, Sixth.**—Thurs., 8 Feb., to Fri., 12 Feb., 1960, at Alexandra Palace, London, N22. Organised by the Stationers' Association of Great Britain Ltd., 6 Wimpole Street, London, W1. Tel. LANgham 9256.

British Toy Fair.—Mon., 15 Feb., to Fri., 19 Feb., 1960, at Brighton. Organised by the British Toy Manufacturers' Association, 93-94 Hatton Garden, London, EC1. Tel. CHAncery 9158.

***Scottish Dairy Show.**—Tues., 16 Feb., to Fri., 19 Feb., 1960, at the Kelvin Hall, Glasgow. Organised by the Glasgow Agricultural Society, 51 Moss Street, Paisley, Renfrewshire.

***Display Market Week, Third.**—Mon., 22 Feb., to Thurs., 25 Feb., 1960, at the Russell Hotel, Russell Square, London, WC1. Organised by the National Display Equipment Association 2 Caxton Street, London, SW1. Tel. ABBey 4813.

Engineering Materials and Design Exhibition and Conference, First.—Mon., 22 Feb., to Fri., 26 Feb., 1960, at Earl's Court, London, SW5. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Scientific Management, 12th International Congress of the International Committee of (COS).—Mon., 22 Feb., to Fri., 4 Mar., 1960, in Sydney and Melbourne, Australia. Organised by the Australian Institute of Management. Inquiries in the United Kingdom should be addressed to the Regional and Overseas Department, British Institute of Management, 80 Fetter Lane, London, EC4. Tel. HOLborn 3456.

Fire Protection Conference, National.—Thurs., and Fri., 25 and 26 Feb., 1960, at the Connaught Rooms, Great Queen Street, London, WC2. Arranged, with the support of the Home Office and the Ministry of Labour and National Service, by the Fire Offices' Committee Fire Protection Association, 31-45 Gresham Street, London, EC2. Tel. MONarch 7412.

Leipzig Spring Fair.—Sun., 28 Feb., to Tues., 8 Mar., 1960, at Leipzig. Consumer goods and technical and capital equipment. Fair offices: Postschliessfach 329, Leipzig C1, Germany. Agents: Leipzig Fair Agency, 39 St. James's Place, London, SW1. Tel. HYDe Park 3111.

IDEAL HOMES

***Ideal Home Exhibition.**—Tues., 1 Mar., to Sat., 26 Mar., 1960, at Olympia, London, W14. Organised by Associated Newspapers Ltd., 161-163 Queen Victoria Street, London, EC4. Tel. FLEet Street 6000.

***Oil and Colour Chemists' Technical Exhibition, 12th.**—Tues., 15 Mar., to Thurs., 17 Mar., 1960, at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Apply to the Oil and Colour Chemists' Association, Wax Chandlers' Hall, Gresham Street, London, EC2. Tel. MONarch 1439.

***Bahrain Agricultural Show and Trade Fair.**—Thurs., 31 Mar., to Thurs., 7 April, 1960, at Manama, Bahrain. Apply to the Department of Public Relations and Broadcasting, Manama, Bahrain, Persian Gulf.

Manned Space Stations, Symposium on.—In April, 1960, at the Ambassador Hotel, Los Angeles, Calif., USA. Organised by the Institute of Aeronautical Sciencies, 2 East 64th Street, New York 21.

Electrical Engineers Exhibition, Ninth.—Tues., 5 April, to Sat., 9 April, 1960, at Earl's Court, London, SW5. Sponsored by the Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (Tel. LANgham 5927); and organised by Electrical Engineers (ASEE) Exhibition Ltd., 6 Museum House, 25 Museum Street, London, WC1. Tel. MUSeum 3450.

Osaka International Trade Fair, Fourth.—Sat. 9 April, to Tues., 26 April, 1960, in Osaka. Offices: Honmachibashi Higashi-ku, Osaka, Japan.

***Scotland's Food Exhibition.**—Tues., 19 April, to Sat., 30 April, 1960, at the Kelvin Hall, Glasgow. Organised by Trades Markets and Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

Office Management, International Conference.—In May, 1960, at Montreal, Canada. Organised by the National Office Management Association. Apply to the Field Service Division, NOMA, 1931 Old York Road, Willow Grove, Penn., USA.

***Grocers' and Allied Trades Exhibition.**—Tues., 3 May, to Sat., 14 May, 1960, at Belle Vue, Manchester. Offices: 393 Corn Exchange Manchester 4. Tel. Blackfriars 4969.

***Hardware Trades Fair, International.**—Mon., 9 May, to Fri., 13 May, 1960, at Olympia, London, W14. Organised by Universal Exhibitions Ltd., 74 Holland Park, London, W11. Tel. PARk 7360.

***Self-Service and Shop Equipment Exhibition.**—Mon., 23 May, to Fri., 27 May, 1960, at Olympia, London, W14. Organised by Universal Exhibitions, Ltd., 74 Holland Park, London, W11 Tel. PARk 7360.

***Royal Ulster Agricultural Show, 93rd.**—Wed., 25 May, to Sat., 30 May, 1960, at the King's Hall, Belfast. Organised by the Royal Ulster Agricultural Society, King's Hall, Balmoral, Belfast.

***Bath and West Agricultural Show.**—Wed., 1 June, to Sat., 4 June, 1960, at the Show Site, Bath. Organised by the Bath and West and Southern Counties Agricultural Society, 3 Pirrepoint Street, Bath. Tel. Bath. 3010.

ENGINEERING IN SYDNEY

***Sydney Engineering Exhibition.**—Mon., 18 July, to Sat., 23 July, 1960, at the Showground, Sydney. Apply to Industrial Public Relations Service (NSW), Pty., Ltd., Box 4962, G.P.O., Sydney, New South Wales.

***British Food Fair, Sixth.**—Thurs., 1 Sept., to Sat., 17 Sept., 1960, at Olympia, London, W14. Organised by the Food Manufacturers Federation, Inc., 10 Mount Row, London, W1. Tel. HYDe Park 2933.

Operational Research, Second International Conference on.—Mon., 5 Sept., to Fri., 16 Sept., 1960, in Aix-en-Provence, France. Organised by the International Federation of Operational Research Societies (IFORS), 11 Park Lane, London, W1.

Photogrammetry, Ninth International Congress on.—Mon., 5 Sept., to Sat., 17 Sept., 1960, in London, under auspices of the International Society for Photogrammetry. Congress director: Colonel J. B. P. Angwin, 18 Cavendish Square, London, W1. Tel. LANgham 1626.

***Brewers' Exhibition.**—Mon., 3 Oct., to Fri., 7 Oct., 1960, at Olympia, London, W14. Organised by Trades Markets and Exhibitions, Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

***Business Efficiency Exhibition, 47th.**—Mon., 3 Oct., to Wed., 12 Oct., 1960, at Olympia, London, W14. Organised by Office Appliance and Business Equipment Trades Association of Great Britain and Ireland, 64 Cannon Street, London, EC4. Tel. CENtral 7771.

***Building Trades Exhibition, 23rd.**—Tues., 11 Oct., to Sat., 22 Oct., 1960, at City Hall, Deansgate, Manchester. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

***Technology of Plastics Processing, International Congress on.**—Mon., 17 Oct., to Wed., 19 Oct., 1960, in Utrecht. Followed by the Second International Plastics Exhibition "macro Plastic".—Wed., 19 Oct., to Wed., 26 Oct., 1960, at the exhibition halls, Utrecht, Netherlands. Organised by N.V.'t Raedthuys Tesselschadestraat 5, Amsterdam, Netherlands. (Alterations to dates.)

***Cycle and Motor Cycle Show, 33rd.**—Sat., 12 Nov., to Sat., 19 Nov., 1960, at Earl's Court, London, SW5. Organised by British Cycle and Motor Cycle Industries Ltd., Eaton Road, Coventry. Tel. COVentry 62511.

***Corrosion Exhibition.**—Tues., 29 Nov., to Fri., 2 Dec., 1960, at Olympia, London, W14. Organised by *Corrosion Technology*, Leonard Hill House, Eden Street, London, NW1. Tel. EUSton 5911.

***Metallic Corrosion, First International Congress on.**—Mon., 10 April, to Sat., 15 April, 1961, in South Kensington, London, SW7. Apply to Lieut.-Col. F. J. Griffin, hon. secretary of the congress, at 14 Belgrave Square, London, SW1.

ACHEMA Chemical Engineering Exhibition.—Fri., 9 June, to Sat., 17 June, 1961, at Frankfurt. Organised by DECHEMA (Deutsche Gesellschaft für Chemisches Apparatewesen), 25 Rheingau-Allee, Frankfurt-on-Main, Germany.

***Nuclear Development: Impact on Electricity Supply and on Instrument Techniques, Convention.**—In September, 1961, in London, Organised by the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

***Federation Internationale de la Precontrainte Fourth Congress.**—In June or July, 1962, in Rome and Naples. Offices: 6 Rue Paul Valéry, Paris 16e; and Terminal House, Grosvenor Gardens, London, SW1. Tel. BELgravia 6661.

MEETINGS AND PAPERS

Association of Supervising Electrical Engineers

BOLTON
"Miniature Circuit Breakers," by J. A. Robbins. Bolton Branch. Railway Hotel, Trinity Street, Bolton. Mon., 2 Nov., 7.45 p.m.
MANCHESTER
"Maintenance of Electrical Switchgear," by F. G. Thompson. Manchester Branch. Engineers' Club, Albert Square, Manchester 2. Wed., 4 Nov., 7.15 p.m.

British Institution of Radio Engineers

LONDON
"Input/Output Devices." Half-day Symposium. Computer Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 4 Nov., 3 p.m.
LIVERPOOL
"Electronics in the Auto-Pilot of the Firestreak Missile," by A. Bedford. Merseyside Section. University Club, 2 Mount Pleasant, Liverpool. Mon., 2 Nov., 7 p.m.

Helicopter Association

LONDON
"Application of the Jet Flap to Helicopter Rotor Control," by R. Dorand. Royal Aeronautical Society, 4 Hamilton Place, W1. Fri., 6 Nov., 6 p.m.

Illuminating Engineering Society

EDINBURGH
"History of Lighting," by S. S. Beggs. Edinburgh Centre. Y.M.C.A., 14 South St. Andrew Street, Edinburgh. Wed., 4 Nov., 6.15 p.m.
GLASGOW
"History of Lighting," by S. S. Beggs. Glasgow Centre. British Lighting Council, 29 St. Vincent Place, Glasgow. Thurs., 5 Nov., 6.30 p.m.
HULL
"Trends in Lamp Design 1884 to 1984," by E. E. Miles. Hull Centre. Offices of the Yorkshire Electricity Board, Ferensway, Hull. Tues., 3 Nov., 6.30 p.m.
NEWCASTLE UPON TYNE
"Lighting and Safety in Building Operations and Works of Engineering Construction," by J. Gordon-Scott. Chemistry Department, King's College, Queen Victoria Road, Newcastle upon Tyne 1. Wed., 4 Nov., 6.15 p.m.

Institute of Marine Engineers

LONDON
"Day-to-Day Management of a Ship and Its Machinery." Discussion. Mon., 2 Nov., 6.30 p.m.*
BRISTOL
"Automatic Boiler Control," by P. A. Gill. West of England Section. The University, University Walk, Bristol 8. Thurs., 9 Nov., 7.30 p.m.
FALMOUTH
"Construction of the Ship," by G. Ridley Watson. Junior Lecture. Technical College, Falmouth. Mon., 2 Nov., 7 p.m.
LIVERPOOL
"Nuclear Propulsion of Ships," by R. P. Kinsey. Merseyside and North Western Section. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Mon., 2 Nov., 6 p.m.
NEWCASTLE UPON TYNE
"Refrigerating Machinery and Its Application in Ships," by Lieut.-Commander M. B. F. Ranken. North East Coast Section. Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne. Thurs., 5 Nov., 6.15 p.m.*

Institute of Petroleum

LONDON
"Oil and Transport," by W. S. Ault. Wed., 4 Nov., 5.30 p.m.*

Institute of Road Transport Engineers

CAMBRIDGE
"Road Surfaces," by G. Grime. Eastern Centre. Golden Hind Hotel, Cambridge. Tues., 3 Nov., 7 p.m.
GLASGOW
"Chassis and Engine Manufacture," by R. P. Chilton. Scottish Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Mon., 2 Nov., 7.30 p.m.
MANCHESTER
"Driving Technique." Discussion. East Regional Centre. Houldsworth Hall, 90 Deansgate, Manchester. Mon., 2 Nov., 7.30 p.m.

Institution of Civil Engineers

LONDON
Presidential Address by A. C. Hartley. Tues., 3 Nov., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"Some Comments on the Classification of Waveguide Modes," by Dr. A. E. Karbowiak; and "Some Comments on Quasi-Optical Methods at Millimetre Wave Lengths," by L. Lewin. Electronics and Communications Section. Mon., 2 Nov., 5.30 p.m.*
"An Analogue Electronic Multiplier Using Transistors as Square-Wave Modulators," by P. Gleghorn. Measurement and Control Section. Tues., 3 Nov., 5.30 p.m.*
"Application of Irradiation in Industry," by M. C. Crowley-Milling. Thurs., 5 Nov., 5.30 p.m.*
BIRMINGHAM
"Electrification of the Atomic Energy Authority's Industrial Group Factories," by J. W. Binns and W. J. Outram. South Midland Centre. James Watt Memorial Institute, Great Charles Street, Birmingham. Mon., 2 Nov., 6 p.m.
DERBY
"The Deltic Locomotive," by C. M. Cock. East Midland Centre. Service Centre of the East Midlands Electricity Board, Derby. Tues., 3 Nov., 6.30 p.m.*
EDINBURGH
"Silicone Electrical Insulation," by J. H. Davis. South East Scotland Sub-centre. Carlton Hotel, North Bridge, Edinburgh. Tues., 3 Nov., 7 p.m.
GLASGOW
"The Geophysical Year 1957-58," by Sir David Brunt. 50th Kelvin Lecture. South West Scotland Sub-centre. 39 Elmbank Crescent, Glasgow, C2. Wed., 4 Nov., 6 p.m.
LEEDS
"Application of Low-Pressure Resins to Some High-Voltage Switchgear Designs," by T. R. Manley, K. Rothwell and W. Gray. North Midland Centre. Electrical Department, The University, Leeds. Tues., 3 Nov., 6.30 p.m.*
MANCHESTER
"Application of Irradiation in Industry," by M. C. Crowley-Milling. North Western Centre. Engineers' Club, Albert Square, Manchester. Tues., 3 Nov., 6.15 p.m.
SOUTHAMPTON
"Review of E.H.T. Airblast Switchgear," by G. K. Simpson. Southern Centre. The University, Southampton. Wed., 4 Nov., 7 p.m.

Institution of Engineering Designers

BIRMINGHAM
Films on "Lubrication." Midlands Branch. Queen's Hotel, Birmingham. Wed., 4 Nov., 7 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Research on Steel and Aluminium Hatchway Beams," by M. N. Parker, K. V. Taylor and J. A. Ross. Tues., 3 Nov., 6.30 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Cooling Coil Problems," by L. C. Bull. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 5 Nov., 6 p.m.*
LEICESTER
"A New Look at Hot-Water Pipe Sizing," by E. W. Shaw. East Midland Branch. College of Technology, Leicester. Wed., 4 Nov., 6.30 p.m.
NEWCASTLE UPON TYNE
"Practical Experiences of Off-Peak Heating by Electricity," by L. W. Bower. North East Coast Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Tues., 3 Nov., 6.30 p.m.

Institution of Highway Engineers

LONDON
"Design of Road Improvements in an Urban Area," by S. E. French. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 6 Nov., 5.30 p.m.*

Institution of Mechanical Engineers

LONDON
"Engine Installation Problems." Discussion. Internal Combustion Engine Group. Tues., 3 Nov., 6 p.m.*
"Design and Testing of Large Gas Ducts," by Dr. A. T. Bowden and J. C. Drumm. Wed., 4 Nov., 6 p.m.*
GLASGOW
"The Hydraulic Turbine in Evolution" by P. Danel. James Clayton Lecture. Scottish Branch. Royal College of Science and Technology, Glasgow. Thurs., 5 Nov., 7.30 p.m.
KILMARNOCK
"The Hydraulic Turbine in Evolution," by P. Danel. James Clayton Lecture. Scottish Branch. Dick Institute, Kilmarnock. Wed., 4 Nov., 7.30 p.m.
LINCOLN
"Modern Foundry for the Manufacture of Small Steel Castings by New Moulding Techniques," by C. B. Carter. East Midlands Branch. Technical College, Lincoln. Wed., 4 Nov., 7.15 p.m.
PORTSMOUTH
"Design and Construction of Power Station Feed Heaters," by J. V. Bigg. Southern Branch. Offices of the Central Electricity Generating Board, Portsmouth. Thurs., 5 Nov., 6.30 p.m.
SLOUGH
"Training of Soviet Engineers," by E. G. Sterland. Eastern Branch. Good Companions Hotel, Stoke Poges Lane, Slough. Tues., 3 Nov., 7.30 p.m.

Institution of Plant Engineers

LONDON
"Constructional Problems Encountered in the Kariba Dam Project," by T. A. L. Paton. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 3 Nov., 7 p.m.*
DUNDEE
"Jodrell Bank Radio Telescope," by C. N. Kington. Dundee Branch. Taypark Hotel, West Ferry, Dundee. Wed., 4 Nov., 7.30 p.m.
EDINBURGH
"Water Treatment in Modern High-Pressure Generating Stations," by A. M. Lockhart. Edinburgh Branch. 25 Charlotte Square, Edinburgh. Tues., 3 Nov., 7 p.m.
LEEDS
"Jodrell Bank Radio Telescope," by C. N. Kington. West and East Yorkshire Branch. Houldsworth School of Applied Science, The University, Leeds. Fri., 6 Nov., 7.30 p.m.
PETERBOROUGH
"Colour Television." Discussion. Peterborough Branch. White Lion Hotel, Church Street, Peterborough. Tues., 3 Nov., 7.30 p.m.

Institution of Production Engineers

NEWCASTLE UPON TYNE
"Production, Fabrication, Properties and Uses of Some of the Newer Metals," by Dr. N. P. Inglis. Newcastle upon Tyne Section. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 2 Nov., 6 p.m.
NOTTINGHAM
"Adhesives in Engineering," by E. J. Catchpole. Nottingham Section. Reform Club, Victoria Street, Nottingham. Wed., 4 Nov., 7 p.m.

Institution of Public Health Engineers

LONDON
"Investigations of Sites for Water, Sewerage and Sewage-Disposal Works." Discussion, introduced by R. P. Whiting. Caxton Hall, off Victoria Street, SW1. Mon., 2 Nov., 6 p.m.*

Institution of Structural Engineers

EDINBURGH
"Jodrell Bank Radio Telescope," by C. N. Kington. Scottish Branch. Adelphi Hotel, Edinburgh. Tues., 3 Nov., 6.15 p.m.
NEWCASTLE UPON TYNE
"Design and Construction of Shell-Roofed Buildings for Cadbury Bros., Ltd., at Moreton," by J. E. C. Farebrother and L. E. May. Northern Counties Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Wed., 4 Nov., 6.30 p.m.
SWANSEA
"Structural Aspect of Pipe Problems," by C. D. C. Braine. Wales and Monmouthshire Branch. Mackworth Hotel, Swansea. Wed., 4 Nov., 6.30 p.m.

Junior Institution of Engineers

LONDON
Various technical films. Fri., 6 Nov., 7 p.m.*

Liverpool Metallurgical Society

LIVERPOOL
"Ductile Fracture," by Professor R. W. K. Honeycombe. Department of Metallurgy, Liverpool University, 146 Brownlow Hill, Liverpool 3. Thurs., 5 Nov., 7 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Machinery for Large Tankers," by G. B. Halley. Andrew Laing Lecture. Hall of the Literary and Philosophical Society, Newcastle upon Tyne. Mon., 2 Nov., 6.15 p.m.

Reinforced Concrete Association

LIVERPOOL
"Reinforced Lightweight Concrete," by A. Short. North Western Branch. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Wed., 4 Nov., 6.30 p.m.*
MANCHESTER
"Reinforced Lightweight Concrete," by A. Short. North Western Branch. College of Technology, Sackville Street, Manchester. Tues., 3 Nov., 6.45 p.m.*

Royal Institution

LONDON
"What Goes on Inside the Stars," by Professor H. Bondi. Fri., 6 Nov., 9 p.m.

Royal Meteorological Society

LONDON
"Ocean Currents," by H. Charnock. Wed., 4 Nov., 5.30 p.m.*

Sheffield Metallurgical Association

SHEFFIELD
"Modern Developments in the Theory of Brittle Fracture," by Dr. A. A. Wells. BISRA Laboratories, Hoyle Street, Sheffield 3. Tues., 3 Nov., 7 p.m.

Society of Chemical Industry

NOTTINGHAM
"Corrosion Factors Affecting the Choice of Stainless Steels for Chemical Plant," by H. T. Shirley. East Midlands Gas Board, 51-55 Lower Parliament Street, Nottingham. Thurs., 5 Nov., 7.30 p.m.

Society of Engineers

LONDON
"Dissemination of Technical Information, with Particular Reference to the Aircraft Industry," by K. A. Steel. Geological Society, Burlington House, Piccadilly, W1. Mon., 2 Nov., 5.30 p.m.*

Society of Instrument Technology

FAWLEY
"Safe Use of Electricity," by S. J. Emerson. Fawley Section, Administration Building, Esso Refinery, Fawley. Fri., 6 Nov., 5.30 p.m.

Women's Engineering Society

LONDON
"Electrical Bowling Alleys," by Don Lockley. London Branch. Hope House, 45 Great Peter Street, SW1. Wed., 4 Nov., 7 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this feature should reach the Editor at least three weeks before the date of the meeting.

* An asterisk is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Helicopter Association of Great Britain, 4 The Sanctuary, London, SW1. (ABBey 5160)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Public Health Engineers, c/o The Portman Building Society, 39 Portman Square, London, W1. (WELbeck 0981)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879)
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Chemical Industry, 14 Belgrave Square, London, SW1. (BELgravia 3681)
Society of Engineers, Abbey House, Victoria Street, London, SW1. (ABBey 7244)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Women's Engineering Society, 25 Foubert's Place, London, W1. (GERrard 5212)

Sir Lewis Casson and Boanerges

The man who ordered the ammunition for the Army in the Second World War and the man whose job it was to see it was produced exchanged deprecating smiles across the platform of the Albert Hall.

They were Lord Weeks, former deputy Chief of the Imperial General Staff, and Sir Graham Cunningham, war-time controller general of munitions production at the now defunct Ministry of Supply. With their Gilbert and Sullivan style titles now long behind them, they were attending this year's commemoration day of the Imperial College of Science and Technology—Lord Weeks as the special visitor; Sir Graham as a Fellow, elected this year and now receiving his "parchment."

In the line of presentation Sir Graham, chairman of the Triplex Safety Glass firm and one time possessor of the nickname "Tiger Tim," followed Sir Lewis Casson, whom few would think of as an engineer.

In fact the distinguished actor, producer and husband of Dame Sybil Thorndike, was a student of the City and Guilds College from 1892-1894. One of his hobbies, ardently pursued, is the construction of cars from parts it would be charitable to describe simply as "used." This is one subject where City and Guilds men, with experience of Boanerges, really can answer questions.

Among the new fellows is Mr. R. McKinnon Wood, well known for his long service to local government in London. Less well known is it that for 20 years he headed the department of aerodynamics at Royal Aircraft Establishment, Farnborough.

Winding Way to the Top

It has often been said, and said repeatedly in these notes, that a first class technologist can well come from a general educational background. An able man can turn to technical specialisation comparatively late in his formative period. An example of this is to hand with the announcement that Mr. M. J. S. Clapham has been appointed chairman of Imperial Chemical Industries metals division as from 1 January, 1960.

Mr. Clapham has been joint managing director of ICI metals division since 1952. He took an honours degree in classics at King's College, Cambridge, in 1933 and served his apprenticeship at the University Press, Cambridge. He progressed through printing to the production of isotope diffusion plant in the atomic energy field. He came into the metals division of ICI as a personnel manager and later became personnel director. His interests have been spread over the industry as a whole as well as in his own company. He is, for example, chairman of the Non-Ferrous Metals Export Group and his continuing interest in education is illustrated from his life governorship of Birmingham University. His career is an interesting example of broad interests and specialisation being moulded into a flexible and successful career.

University at Norwich

A site of 250 acres has been provided by the Norwich City Council for a university. The site, which is at Earlham, is owned by the Council whose members thought it "better to sacrifice their 130 acre municipal golf course rather than spend up to £175,000 to acquire a site at Eton (on the main approach road from Norwich) which had been suggested by the town planning committee. The committee's preference for the Eton site was because of its close proximity to main roads and houses.

The chairman of the university promotion committee, Mr. Norman Tillett, described the plan to build a university as "the most important thing which has been envisaged for the city of Norwich since the building of the cathedral 800 years ago."

Money without Moons

A frank and well presented explanation of financial results has been published by the Davy-United group for their employees in the form of a booklet entitled "The Money—1959." Its six uncrowded pages are divided into five sections; each made as personal as possible: What we have earned in 1958/59; Our balance sheet in 1959; How we have grown in 10 years; Meet the shareholders, and What are our prospects.

The approach is factual and the accent on simplicity. The objective is to promote understanding and interest—the results and accounts of the group are therefore presented in a form employees of all levels can understand without affront to their intelligence. There are, for example, no moons representing the pound of turnover in brightly coloured sections. Earnings are shown under all useful headings, which a financial man would need for his understanding, and all amounts reduced in terms of "cash pound received from customer." When the turnover of £14·59 million equals £1: materials and services £10·28 million equals 14*s* 1*d* of the pound, wages salaries, pensions, etc., £2·53 million or 3*s* 6*d* and so on. The balance sheet is explained quite simply and the growth of the business reviewed over ten years in financial terms. The growth in the value of the group, from £1·63 million in 1949 to £5·77 million today, is shown as arising "mostly from profits ploughed back" which have gone "into new buildings, machine tools, a fettling shop and other assets of a permanent nature."

The shareholders are analysed into four main categories and the 47 (out of 2,032) who hold £10,000 stock and over are listed. The largest individual holding is 7 per cent and insurance companies together own about 25 per cent. Pointing out that there is nothing abnormal about this, the booklet states that insurance companies are the biggest investors in industry today but that they do not interfere, seeking simply "a sound investment for the life savings of a multitude of policy holders."

Price de Resistance

Technical problems in the motor vehicle industry were discussed in a recent paper given by Mr. L. H. Dawtrey, chairman of the automobile division, to his section of the Institution of Mechanical Engineers. Mr. Dawtrey is Chief Engineer (Research and Development) of the Standard Motor Company Limited. One of his topics was the effect of roof luggage on car performance. Engineers, like other men, are under pressure to load a car on the assumption that its carrying capacity is a function of the family's wishes and not of the car's specified performance. They may like to have Mr. Dawtrey's calculations handy.

In his paper he produced a table which shows the effects of roof luggage on performance. In four tests he records the combinations of two occupants and roof luggage. Perhaps tests two and four will serve to illustrate the cost of roof luggage. With no roof luggage but fully laden, fuel consumption at 60 m.p.h. was 29·5 m.p.g., while with abnormal roof luggage (quite common) it was 19·5 m.p.g. With the abnormal roof luggage frontal area was increased by 25 per cent but air resistance by 230 per cent, requiring twice as much horsepower to drive a car at 65 m.p.h. The driver should console himself, he thinks, with the thought that he can rarely travel any great distance at 65 m.p.h. The extra cost presumably is part of the holiday bill.

Of Cars and Men

We were told during the election that workers—meaning weekly wage earners—who go to work in cars are the symbol of symbols of prosperity and well-being. One party pointed to it as evidence that the country had never had it so good, the other campaigned for a greater sharing of the nation's wealth to make more of it possible. The motor manufacturers themselves gave concrete evidence of their belief that it could and would come about by launching small cars costing less than £600. Everyone already knows them, for manufacturers' publicity has been on an unprecedented scale: BMC's identical twins, the Austin Seven and the Morris Miniminor, and Ford's Anglia. Most workers on skilled jobs earn enough to buy these cars with less than six months wages. In practical terms they can acquire such a car by paying some £50 to £60 deposit and £15 a month or less. There are hundreds of thousands—one is tempted to say millions—who can and will do this. Should the unexpected happen and price resistance set in, there is scope for the Government to reduce the incidence of purchase tax and, probably, for manufacturers to reduce their prices. The stage is set therefore for a very large increase in the number of cars on British roads, and at a rate which cannot be matched even by the most lavish and urgent road building programme.

What next? Few voices have been raised publicly so far in warning of what must happen. Perhaps it is as well to allow experience to form our judgments. There will be an increased crop of accidents and agonising congestion. But something will probably be done to raise driving standards and to improve road manners. Every motorist already knows that our roads could hold over twice the number of cars in greater comfort than at present if drivers would take only the room they need. He knows also that care can greatly reduce the risks of having an accident. Perhaps it will be on the road that we shall acquire new standards of social intercourse, above all generosity and courtesy. Until we do, it will be quicker and safer by train.

Heli-Hospitals

A new conception of mobility for hospitals with the help of helicopters was introduced at the annual exercise of the Army Medical Services at Mytchett last week by Westland Aircraft. It is based on the lifting of "pods," which are containers constructed as ambulances to carry 40 casualties, or a field medical station with all its equipment, capable of taking care of 100 patients for eight days, or a self-contained operating unit. A Westminster helicopter would carry the unit short distances to the desired location, thus avoiding the contamination which may be inescapable by ground transport and the disruption caused by packing up and loading into lorries.

The utility pod demonstrated at Mytchett was 10·5 by 8·5 by 3·0 ft; fitted out as a mobile operating unit. It had large let-down doors at each end for rapid on-off loading. Two small doors on each side lead into large, lean-to tented structures with rigid flooring. The total floor area of the pod and structure was 1,500 sq. ft—nearly as large as a tennis court. It was proposed that it should be used as a central sterile area for scrubbing up, sterilising, storage and so on, while the tented structures allowed a two-way flow of casualties through ananaesthetic room, an operating room and a recovery room on each side of the pod. By dispensing with the recovery room, thus increasing the size of the operating room, a four-way flow could be achieved.

Thermonuclear Revival

DURING recent months two conferences of major importance were held in quick succession; both related to aspects of research which may or may not lead to the achievement of controlled thermonuclear reactions. It is significant that although thermonuclear research was implicit in the topic of both conferences, the title of neither gave indication of this. The Uppsala conference was on ionisation phenomena in gases, while the London conference dealt with the physics of very high temperatures. The implications are twofold. With the expansion of thermonuclear research appreciable specialisation is already occurring within that field; and lack of spectacular results in achieving controlled fusion tends to place emphasis on details where progress has been considerable. A special correspondent reports on the two conferences below.

Changing Pattern at Uppsala

The international conference on ionisation phenomena, which has been held every two years since 1953, was this year invaded and almost swamped by scientists and engineers working in the field of controlled thermonuclear reactions. At the first two conferences of the series there were no thermonuclear papers presented, while at Venice in 1957 only a handful of papers managed to get through the barriers of secrecy and occupied only a morning session of the four day conference. This year, with the secrecy restrictions gone, about half the conference was concerned with thermonuclear work and for most of the five day conference four parallel sessions were necessary.

Effects of Free Exchange

Coming a year after the full exchange of information on thermonulcear research at the 1958 atomic energy conference at Geneva, the papers were largely progress reports for the intervening year. No major discoveries have been made during the year, but there has been progress in the understanding of the complex behaviour of hot ionised gases in the presence of confining magnetic fields. The progress in pure science seems considerable, but from the viewpoint of useful thermonuclear power it has been only a modest step on the long road to success.

Scylla's Mirror

Although the pinch effect method is still the most popular approach to producing the very high temperature gas required for a thermonuclear fusion reaction, the limelight was stolen by the magnetic mirror experiments with very fast compression. At Geneva last year two experiments of this type were reported, one at Los Alamos Scientific Laboratory, known as "Scylla," and the other at the US Naval Research Laboratory, Washington. The nuclear reactions occurring in Scylla were unique in that the emitted neutrons were shown to be isotropic —a property which neutrons from thermonuclear reactions must have. The Scylla discharge was therefore the only one for which a possible thermonuclear reaction could be claimed (ENGNG., 26 Dec. '58, p. 824). It was not surprising to learn at Uppsala that at least six other laboratories in the United States, the United Kingdom (at AWRE), the USSR, Germany, France and Italy had taken up the study of this type of discharge although the two original laboratories have retained their lead.

Circumstantial Evidence for Fusion

At Los Alamos and Washington, experiments have revealed the detailed properties of discharges in magnetic mirror machines. Magnetic spectrometer measurements made on the fast tritons and protons emitted from the reactions have shown the correct energy spectrum for a deuteron temperature of 12 million degrees. Soft X-rays were detected coming from the gas—the first time for any discharge. (Previously X-rays have been detected coming only from the tube walls caused by fast electrons escaping from the discharge). Such X-rays are expected for electron temperatures above about a million degrees; the X-ray spectrum indicated an electron temperature of 2·5 million degrees.

Causes of Heating

The evidence thus pointed to a thermonuclear cause for the reactions as opposed to a spurious acceleration of a few deuterons to high energies. But the scientists disagreed strongly over the nature of the heating mechanism causing the reactions. The Los Alamos scientists suspected the initial shock wave and the subsequent adiabatic compression; most of the other experts thought that instabilities played a large part in the heating. The workers at Washington showed that nuclear reactions occurred only under conditions which favoured the growth of instabilities, and the beautiful high speed photographs taken at AWRE showed that in their experiments instabilities were present at the time of neutron emission. If instabilities are the cause of the high temperatures, it is much less likely that these devices can be scaled up to produce still higher temperatures and useful power.

Pinch Instability

In the pinch effect experiments such as Zeta and Sceptre, the results of the past year indicate that although the gas is stable against the gross wriggle instability which plagued this type of discharge several years ago, there is still a smaller scale instability present. The instability is probably causing the observed high rate of escape of electrons through the confining magnetic field. The evidence is growing that the Doppler broadening of spectral lines observed with Zeta and Sceptre is connected with true ion temperature. The ion temperature is in the range of 3 to 5 million degrees, whereas other measurements have shown that the electron temperature is only 0·2 million degrees. The electron temperature is limited by the high rate of electron loss to the walls, with cold electrons returning to the gas; and by the ultra-violet radiation which the electrons induce in impurities evaporated from the walls.

Magnetic Levitation

Several attempts have been made in the United States to suppress the small scale instability by extra magnetic fields applied to the discharge. Success has been achieved in only one case, and that by taking the drastic step of putting a copper rod down the centre of the discharge tube. The self-magnetic field of a high current passed through the rod pushes the hot gas away from the rod and an applied axial magnetic field keeps the gas from touching the outer walls. Experiments in a straight tube have confirmed that such a configuration is much more stable than the normal pinch discharge. The toroidal version of this experiment—the Levitron—is being built at Livermore, and will involve the electromagnetic levitation of a copper ring within the toroidal tube.

Plasma Oscillations

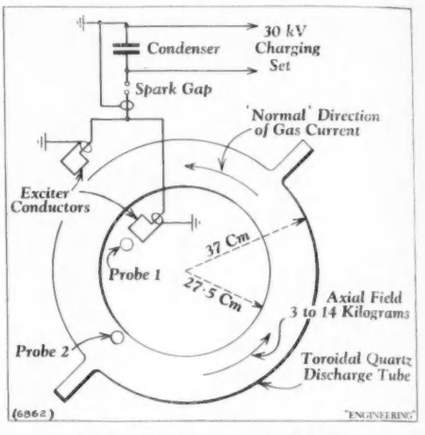
The scientists working on rotating plasmas at Berkeley and Los Alamos have reported that they too are troubled with instabilities. The "Stellerators" at Princeton still have the high rate of loss of plasma from the discharge; the theoretical workers there think the cause is high frequency electron plasma oscillations rather than the hydromagnetic instabilities common to most other devices. Workers with d.c. magnetic mirror machines reported steady progress in developing ion sources and the techniques to inject and trap the ions.

Feeling the Pinch in London

At the high temperature physics conference in London, most of the papers were closely connected with the quest for controlled fusion reactions, with a few papers on the analogous problems met in the ionised gases of astrophysics. It was essentially a national gathering on a much smaller scale than that at Uppsala. However, the large number of people who attended showed the growing interest in the field in the United Kingdom. In addition to the two original centres for this research at AERE, Harwell and the AEI Research Laboratory, Aldermaston, a substantial team has now been built up at AWRE, Aldermaston; and smaller teams at Imperial College, London; at the BTH Research Laboratory, Rugby; at SERL, Baldock; and at ERA, Leatherhead; and many scientists at other establishments have at least an indirect interest.

Progress Reports from UK

Many of the contributions were repeat performances of papers presented at Uppsala. The results from Zeta at AERE, and Sceptre III at AEI, and on the fast mirror experiment (Thetatron) at AWRE have been mentioned above. Other points of interest include the fact that Zeta has recently been modified to increase the condenser bank energy from 5×10^5 to 3×10^6 joules. Gas discharge currents up to about 700,000 amperes have been achieved. At AEI a new experiment, Sceptre IV, is nearing completion and involves a condenser bank energy of 10^6 joules and a new torus consisting of 24 sections of vacuum cast copper. Work at AWRE and at Imperial College on the pinch discharge in a straight tube has shown that there is still a lot to be learnt despite the many years it has been studied. Improved high speed photography has shown that when the discharge is constricted at the centre of the tube, gas is evolved from the tube wall and becomes ionised and conducting outside the main column. The cause is almost certainly ultra-violet radiation from the discharge heating the insulating tube wall. At AWRE plans are being drawn up for a d.c. mirror machine which will inject high energy neutral atoms to be ionised and then trapped within the magnetic field. From BTH there were preliminary and so far disappointing results on the combination of a magnetic mirror field with a straight pinch discharge. At ERA a study is being made of the high current low pressure carbon arc which is used at Oak Ridge to dissociate the molecular beam in the direct current mirror machine DCX.



Discharge machine to study Alfvén waves.

Central Facility for Thermonuclear Research

The UKAEA has announced plans for the creation of a central research facility for plasma physics and thermonuclear reactions. The new establishment will be located at Culham, Oxfordshire, on a 175 acre site belonging to the Royal Naval airfield. Most of the thermonuclear research now carried on at Harwell and Aldermaston will be moved to the new site. A new machine incorporating the results of experience with Zeta and other thermonuclear devices will be built. The name of the machine will be ICSE, or intermediate current stability experiment. It is planned that in four or five years the staff at Culham will rise to 1,000.

Back to Fundamentals with ICSE

Construction of the intermediate current stability experiment (ICSE) at the new thermonuclear research establishment of the UKAEA is a return to first principles. There will be no attempt to produce thermonuclear reactions in the new device, which is designed simply to test theories of stability and energy loss. After the failure of Zeta to produce a stable plasma of sufficiently high temperature to produce thermonuclear reactions, a series of investigations revealed the fundamental processes of encrgy loss. These were the production of plasma jets or "runaway electrons"—electrons unintentionally accelerated to relativistic energies—and the wriggling of the plasma which brought it in contact with the surfaces of the machine. The new theories of energy loss and its control will be put to the test in the machine. ICSE will also be toroidal but physically larger than Zeta. It will be a fast pinching machine requiring an energy storage of 3 to 10×10^6 joules. The discharge instability will be controlled by two magnetic fields; an externally applied variable field, and a trapped magnetic field established in the torus prior to the discharge. Theoretical considerations of plasma stability require that the two fields be applied "crossed." An attempt will be made to suppress the creation of relativistic "runaway" electrons by increasing the plasma density and by using very fast —"explosive"— discharge.

Pinch Stabilisation by Trapped Magnetic Fields

If a magnetic field is established in a pinch device prior to the electrical discharge, some of the field will

be trapped by the enveloping waves of plasma. The trapped field has the effect of retarding the process of pinch formation and also tends to suppress instabilities. Dr. G. H. Cole reports in his article "The Pinch Effect" (*Science Progress*, vol. 47, No. 187, p. 437) that magnetic trapping is an effective stabiliser of perturbations of short wavelength only; to control other instabilities a strong external magnetic field must be applied anti-parallel to the trapped field. A mathematical analysis which considers the plasma as a static tube of infinite length—suitable only for slow pinching—indicates that although a pinched discharge is inherently unstable, the application of a trapped and an external magnetic field of proper relative strength will result in a stable plasma provided the discharge tube has electrically conducting walls and a suitable geometry.

Stable Plasma Claimed

The United States Naval Research Laboratory claims the achievement of stable plasma of 5 to 10 microsecond duration with temperatures in the order of 20 million degrees centigrade in their 12 in long magnetic mirror machine. During the discharge the emission of neutrons was observed. As no acceleration effects operate in the stabilised plasma it is believed that these neutrons are of thermonuclear origin and do not result from plasma instability. The bulk of the neutron emission observed in the British Zeta experiments was attributed to the instabilities. The laboratory plans the installation of a larger condenser bank capable of producing a peak current of 60 million amperes. The resulting maximum plasma temperature is expected to be 50 million degrees and it is hoped that the experiments will provide direct proof of thermonuclear reactions instead of the circumstantial evidence available at present.

Basic Electrodeless Discharges

Although electrodeless discharges are used extensively in thermonuclear experiments to produce shock waves in plasmas, there have not been many experiments studying the basic phenomena of the electrodeless discharge itself. The point is taken up by J. K. Wright, W. T. Eeles, and J. D. Herbet, AWRE Foulness, in a letter to *Nature* (p. 1665, 13 June). They outline their own investigations of electromagnetically driven shock waves generated by this method. They use a Perspex pill box, 3·1 cm diameter by 2·2 cm high, wrapped with a single turn coil and filled with deuterium at 0·1-2 mm mercury. Switching on an 8 μF low inductance capacitor across the coil generates a fast-rising current, and, under certain conditions of gas pressure and with the aid of some pre-ionisation, produces a cylindrical current-sheet in the gas at the pill-box circumference. As the induced current is in the opposite sense to that in the coil, the resultant repulsion gives rise to strong shock waves in the gas. Some of the magnetic field from the original coil current becomes trapped in the current sheet and prevents the imploding shock wavefront reaching the centre of the pill box. It is possible to cancel out the effect of the trapped field by superimposing a steady magnetic field of the order of 1,000 oersteds. This greatly increases both convergence and speed of the shock waves and may have important applications in producing high temperature plasmas—the temperature of gas undergoing shock waves varies as the square of the shock speed. The authors consider in more detail the interaction of the imploding shock wave with the trapped magnetic field, pointing out that their experiments number among the few cases where laboratory scale hydromagnetic interactions with magnetic Reynolds numbers in excess of unity can be studied. Astronomical systems normally have such magnetic Reynolds numbers. The authors also discuss the minimum gas pressure for breakdown at various voltages.

Heating the Gas

A gas can be ionised and heated, in general, by energetic particles, by photons, or by electric fields. Consideration of heating in a stellarator has been limited to electric fields. Two general types of heating by electric fields may be distinguished, depending on whether the electric field, *E*, is parallel to or perpendicular to the magnetic field, *B*. In the configuration of the stellarator, an electric field parallel to *B* can be produced only by induction, by changing the magnetic flux threading the toroidal tube. Since the current induced by this field heats the gas by ohmic, or Joule, losses, this process is known as "ohmic heating." An electric field perpendicular to *B* could be produced electrostatically. However, a plasma shields itself so effectively against electrostatic fields that primary consideration has been given to electric fields induced by pulsating the magnetic field. Heating by this method is called "magnetic pumping" (which is analogous in some way to the heat produced in a bicycle pump) or, in the special case that the pulsation frequency is chosen close to the ion cyclotron frequency, "ion cyclotron resonance heating" . . . . Pulsation of the confining field at the cyclotron frequency of the positive ions should give very rapid heating at very low ion densities. The effect is most conveniently understood not as a macroscopic pumping but as a microscopic resonance between the oscillating electric field and the gyration of the positive ions. However, this type of heating produces separation of charges and at appreciable plasma densities the resultant electrostatic fields prevent any appreciable heating. (P 2170 *The Stellarator Program*, L. Spitzer, USA.)

Stellarator Ohmic Heating

In *Physics of Fluids* (Vol. 2, No. 1, p. 57), W. Bernstein and A. Z. Kranz compare theoretical predictions for ohmic heating in the B-1 stellarator with experimental data. They find that in the early stages of this discharge, agreement between theory and experiment is good and the predicted scaling laws are valid, but it is found that in practice it takes five times longer than predicted to complete the first ionisation, and the current levels off at a time when theory predicts continuous heating. To explain these discrepancies, three energy sinks are postulated: cold neutral particles entering the discharge, runaway electrons leaving the discharge, and radiation from impurities. The hydromagnetic instability predicted by Kruskal is given the physical characteristic of an increased rate of diffusion.

Alfvén Waves in Plasmas

A method that could possibly be used to determine the ion density of plasmas in magnetic fields and also their electron or ion temperature is suggested in an article "Alfvén Waves in a Gas Discharge," by D. F. Jephcott (*Nature*, p. 1652, 13 June). The author, at AERE Harwell, recalls that Alfvén predicted the possible existence of magnetohydrodynamic waves, which may be regarded in the simplest case as transverse oscillations of magnetic field lines carrying with them a surrounding inviscid perfectly conducting fluid The velocity of propagation was shown to be dependent on magnetic field strength, on the number of particles in unit volume, and on particle mass. The theory can be extended for compressible fluids (an ionised gas) provided the waves have small amplitude and a frequency low compared with the ion cyclotron frequency. A diagram of the equipment used by the author is shown opposite. With toroidal discharges of 10 kA and 200 μsec duration in monatomic gases at initial pressures of about 100 μ, conditions were quiescent enough for the detection of Alfvén waves. When the gas current reached its peak value, the condenser was discharged through the exciter conductors close to the torus wall. The condenser circuit oscillated at 260 kilocycles per second giving rise to torsional oscillations about the circular axis of the torus. These were detected by two magnetic probes. The measured variation of the velocity of the waves as a function of the axial field showed agreement with theory, except for xenon where the wave frequency was greater than the ion cyclotron frequency. The wave velocity should indicate the ion density; and measurement of the damping should indicate the degree of ionisation, or the electron temperature, or the ion temperature, depending on the dominant dissipative process.

The Ion Magnetron

Three workers at the Lawrence radiation laboratory in Berkeley, California—J. D. Gow, Lloyd Smith and J. M. Wilcox—describe an experiment known as the ion magnetron, in which a plasma is created in a geometry similar to that of the well-known electron magnetron tube. An electron sheath forms about the central anode, and most of the applied-voltage drop occurs in the sheath region. Ionisation of neutral molecules in the sheath provides an irreversible mechanism for injecting high-energy ions into the containment region. (*Nuclear Science Abstracts*, Vol. 13, No. 13.)

Higher States of Matter

The state of matter—solid, liquid, or gaseous—is defined by the degree of freedom with which its thermodynamic equation of state must contend. With the widespread application of plasma research it has become commonplace to talk of plasma—an electrically neutral mixture of ions and electrons—as the fourth state of matter because the electron-ion separation introduces a new degree of freedom. Two CERN scientists, D. Finkelstein and P. A. Surrock, speculate on even higher states. A nuclear plasma composed of free neutrons and protons in space would be a fifth state in which the intranuclear degrees of freedom are excited. Finally, the liberation of the internal degrees of freedom in the subatomic particles—in pair production or meson production for instance—would lead to a sixth state of matter which might be called elementary particle plasma. At the moment no higher states can be imagined although continued high energy research may lead to the discovery of further differentiation in elementary particles. Turning to speculation on the relative abundance of various states of matter, on earth the higher states are found only in minute quantities and only for brief periods of time. The fourth state—ionised gases—exist in fluorescent tubes and in the path of ionising radiation, but the fifth and sixth states occur only in nuclear explosions and high energy laboratories. Outside the earth the balance changes and indications are that the higher states predominate. The Van Allen belt of radiation, the luminous stars, cosmic rays, in fact most of the universe probably consists of higher states of matter.

From Alpha to Zeta

The Russian thermonuclear device Alpha, which is very similar in size and performance to the British machine Zeta, was constructed and put into operation in only four months. This was revealed by Mr. John A. McCone, chairman of the USAEC, who has recently returned from a visit to the USSR where he and a team of five American experts inspected atomic energy and research establishments. Mr. McCone commented that construction of the Alpha in such a short time was an example of the feats the Soviet system of society can achieve if they set their minds to it. Mr. McCone is of the opinion that "Alpha is a copy of Zeta."

Notes and News

New Fuel Fabricating Methods

A novel method of fabricating uranium oxide fuel elements is under development at Chalk River. Instead of forming uranium oxide pellets from powder and consolidating the compacts by sintering, the new process would fill the fuel-element sheath directly with powder. Compaction is attempted by swaging the sheath on to the powder filling. The process has so far been unsuccessful owing to the cracking of the zirconium sheath under the severe metal-working strain, but work is continuing at Chalk River. Mr. H. Clayton, liaison officer for Atomic Energy of Canada Limited, said that present fuel manufacturing techniques are similar to Swiss watchmaking, and to make nuclear power competitive the methods of the German toy industry must be adopted. The new process, if successful, is expected to result in a significant reduction of fuel element manufacturing costs.

Diversification of English Electric

Recent advertisements placed by English Electric to fill staff vacancies at the atomic power division indicate that the company is undertaking a diversification of its nuclear programme. Future development will include in addition to the gas-cooled reactor the organic moderated and the advanced gas-cooled reactors with direct or indirect gas-turbine cycles. Both land based and marine applications are considered. Of the major reactor companies English Electric, NPPC and APC were the only ones not to submit proposals to the Galbraith committee, though English Electric proposed an organic moderated design at a later date in conjunction with Atomics International of America.

Percentage Point

On page 378, column 3, of last week's Atomic Review describing the reheat steam cycle of the Canadian organic-cooled heavy-water reactor, it was erroneously stated that "single-stage reheating will improve the cycle efficiency by 1 per cent," and that the "theoretical cycle efficiency is 6 per cent better than the best pressurised heavy-water reactor to date." The correct text should have read "1 percentage point" and "6 per centage points" respectively. The difference is illustrated by the example of an extraction process, the efficiency of which has been raised from 1 per cent to 2 per cent. The result may be thought of as a difference of 1 percentage point; but also as an improvement of 100 per cent.

Aeronautical Exhibits at Science Museum

Extensions are now being made to the Science Museum in London, and the new Centre Block will house the National Aeronautical Collection. Exhibits will be viewed from a raised gangway.

The basement and ground floor of the centre block were built and rough finished for the Science Exhibition of the Festival of Britain in 1951, since when the building has been closed to the public. Work was resumed in April 1959 and it is hoped to have the building ready for occupation by December 1960.

The top floor has been allocated to the Aeronautical Collection, and a specially designed gallery (with a floor area of 18,000 sq. ft) will be used to show a number of aircraft that have been in store for some time, as well as several that have been acquired specially for this new display.

New exhibits are also being made for the collection. These include technical ones, to illustrate aircraft construction, design and component operation, and others of a more instructive and educational nature.

Fig. 1 (left) The Iron and Steel gallery, after reorganisation this year.

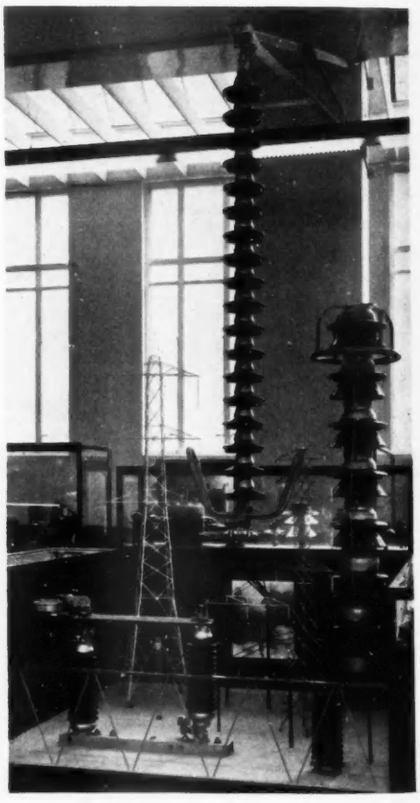


Fig. 2 (right) Some of the exhibits in the Electrical Power gallery.

The aircraft industry is asked to cooperate in this major reorganisation by offering the museum financial assistance and lending objects to be put on show. Estimates for a few items only can be given at present (for example, the demonstration supersonic wind tunnel at £1,500), but based on the experience gained with the reorganisation of other Museum galleries, it is estimated that at least £30,000 is required to produce an exhibit of the same standard as these others. The Government contribution, for the building and furniture, will be nearly £200,000.

The role of the Museum, in the drive to recruit more scientists and engineers, is to stimulate the interest of young people in pure and applied science and to encourage them towards a career in this field. If the interest of their parents can also be gained, so much the better. Industry generally has always supported the Science Museum and recognises the importance of showing its products to visitors from home and abroad. These facts have been recognised by groups of manufacturers who have contributed in recent years to the reorganisation of galleries associated with their industries.

Examples are:

Iron and Steel Gallery

This gallery was reorganised and opened in February, 1959. The cost of the reorganisation, £60,000, was met by the British Iron and Steel Federation. The exhibits shown in Fig. 1 tell the story of the development of the industry from prehistoric times to the present.

Electrical Power Gallery

The cost of the reorganisation of this gallery (opened in May, 1957) was £75,000, met by both the supply and manufacturing sides of industry. (Fig. 2)

Exhibits include a 275 kV insulator string, a 275 kV post insulator and models of transmission towers.

Gas Gallery

Opened in 1954. The gas industry contributed £41,000, in addition to models, for new exhibits to be purchased.

Agricultural Gallery

The 20 leading firms in the industry, although not organised as a group, made contributions amounting to a total of about £10,000 to modernise the collections.

Contributions are being received from the chemical and automobile industries towards the cost of reorganising their respective collections in the Museum. In all cases the contribution by the Museum and the Ministry of Works in the provision of buildings, furniture, services, models and settings has been about the same or greater.

Since 1950 the annual attendance at the Museum has exceeded one million, a figure which will increase as new galleries are opened. At least 1½ million visitors a year are expected when the centre block is completed.

AERONAUTICAL COLLECTION

The aim of the aeronautical collection, in addition to preserving historic relics, is to show present-day practice, in relation to the history of the subject, by using the exhibits as three-dimensional illustrations. The style of exhibition has to cater for different types of visitor, from experts to reasonably intelligent laymen, and yet it must be understood by young people. The specialist is not ignored: indeed, it is recognised that often he can obtain a broader view of his own subject by studying the Museum collections as a whole.

The floor space is to be 225 ft long by 80 ft wide, an area of 18,000 sq. ft. This is half as big again as the existing Western Galleries of Imperial Institute, where the aircraft are now housed. This old gallery is scheduled for demolition (along with Imperial Institute) in 1961, to make way for new buildings for the greatly enlarged aeronautical and scientific research departments of the Imperial College of Science and Technology. A smaller adjoining gallery of 2,500 sq. ft has been allocated for an undeveloped section (as yet) on astronautics and rocketry.

The roof of the main gallery will be of cantilever hangar-type construction so that the aircraft can be suspended from it. The maximum internal height is 30 ft and since there are no columns, good use can be made of the space.

The furnishings of the gallery are to be designed and supplied by the Ministry of Works. The main feature is a walk-way, 9 ft above floor level, so that the aircraft can be viewed from the side or from above. Windows, down to floor level, extend the full length of the gallery. The problem of where to place exhibition cases will be solved by putting most of them under the walk-way.

Full-size aircraft on exhibition at the present time include: a reproduction of the Wright Biplane (1903); a Roe Triplane (1909); Vickers Vimy, Alcock and Brown (1919); de Havilland Moth, Amy Johnson (1930); Supermarine S6B (1931); V1 Flying Bomb (1944); Canberra cockpit (1952). The last mentioned is the cockpit of the aircraft that made the first double crossing of the Atlantic in one day. It forms a complementary exhibit to the Alcock and Brown machine. Presented by the English Electric Company Limited in April, 1959, and intended for the centre block display, it is already on show.

In addition to the above machines, it is planned to show a number of aircraft now in store, such as: Cody Biplane (1911); Avro 504K (1918); Westland-Hill Pterodactyl (1926); Cierva C30a Autogiro (1935); V2 Rocket (1944).

Items specially acquired for the new exhibition are: Supermarine Spitfire (1940); Hawker Hurricane (1940); Messerschmitt Me163 (1944); Rolls-Royce vertical take-off test rig for the " Flying Bedstead " (1954).

Not all these machines are in good enough condition to be a credit to the manufacturers or to the National Collection of Aeronautics and assistance is required to bring them up to scratch.

Promises have been received for some of this work to be done.

The Royal Aeronautical Society has suggested that one or two of the Nash collection may be available for the Science Museum display. The final selection, to be made in consultation with the RAeS, will be made with a view to the historical aspect and the condition of individual machines.

AIRCRAFT STRUCTURES

At present, only a few exhibits show the complexity of modern aircraft and this section will have to be enlarged considerably if the visitor is to understand the working of an aircraft and appreciate the importance of structural design, and ancillary equipment. There is one such item in the Instrument section, however. Made a few years ago by the Sperry Gyroscope Company, it shows an artificial horizon and gyrosyn compass under working conditions. It has since been converted into a continuously working model.

Assistance with three major technical exhibits has already been provisionally arranged with manufacturers. These are listed below as examples of the type of exhibit required:

(1) Section of Viscount Fuselage

A section of fuselage (10 ft diameter and 4 or 5 ft long) will illustrate fuselage construction. One half will be furnished with seats to show an airliner interior. (To be contributed by Vickers-Armstrongs (Aircraft) Limited.)

(2) Undercarriages

Contemporary undercarriage gear will be represented by a sectioned Hawker " Hunter " main leg and the main leg of an Avro " Vulcan." It is also hoped to get hold of a working undercarriage leg. (To be contributed by Dowty Group Limited.)

(3) Wing Section

A section of a " Twin Pioneer " wing, showing its construction and the mechanical operation of slots and flaps. (To be contributed by Scottish Aviation Limited.)

MODEL AIRCRAFT

On show also will be nearly 200 models illustrating the development of all types of aircraft. It is hoped that many gaps in this comprehensive collection will be filled and that a number of models not of standard size, or below the desired accuracy, will be replaced rather than eliminated.

Typical of the new displays being devised is one illustrating the rise in maximum speed of fighter aircraft, from the Vickers FB5 to the English Electric Lightning. Models will be mounted at suitable points along a curve of speed performance, so all these models will have to be to the same scale. Several highly detailed sectioned models (to a larger scale of $\frac{1}{12}$) are also required (e.g., contemporary airliner, freighter, fighter, helicopter, and so on). It is hoped that manufacturers will be willing to lend or present models of their aircraft for the series to a scale of half an inch to the foot ($\frac{1}{24}$).

AERODYNAMICS SECTION

Additional space in the centre block has been allocated for educational exhibits in aerodynamics. Plans for the section include:

(i) Simple smoke and wind tunnels to illustrate the flow of air over wing sections and how an aircraft gains lift.

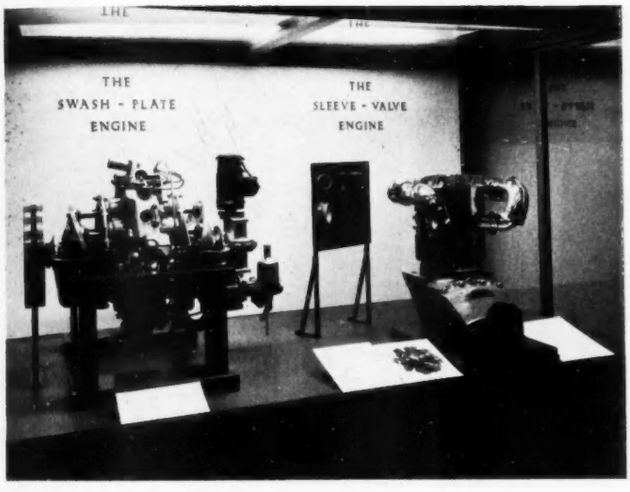
(ii) Similar tunnels to illustrate stalling and the effect of slots and flaps.

(iii) Supersonic flight: a water tray analogy to supersonic flight and a simple blowdown supersonic tunnel to illustrate shock wave formation by the Schlieren system.

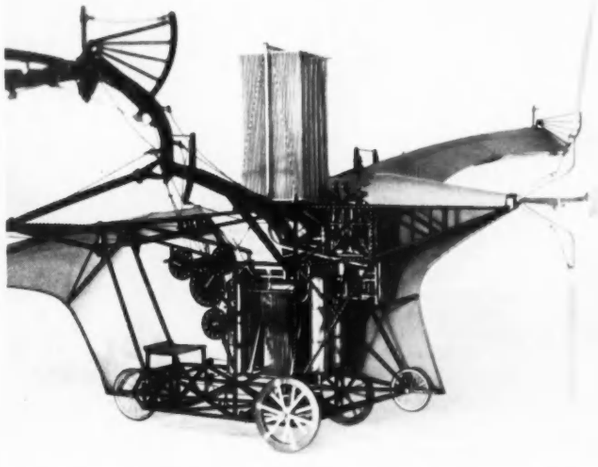
Simple wind and smoke tunnels have been devised by the Museum for (i) and (ii) but development work is required before final manufacture. An elementary supersonic wind tunnel is available commercially and it is hoped to acquire one of them.

AIRCRAFT ENGINES

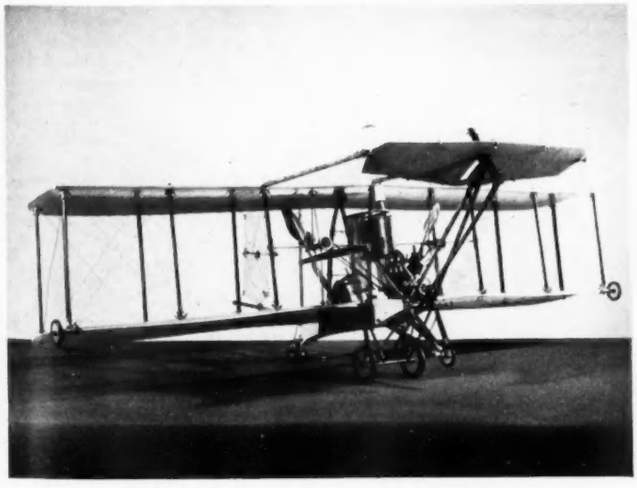
The collection of aircraft reciprocating engines is recognised throughout the world as being most comprehensive. The condition of a few of the engines could, however, be improved. The continued assistance of industry in regard to new jet engine exhibits is confidently expected.



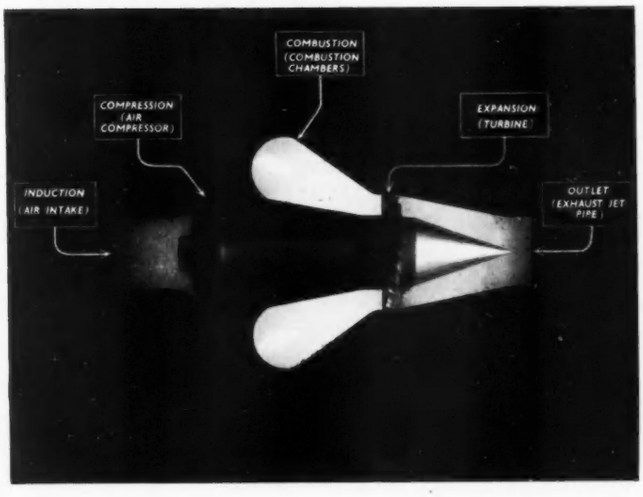
Wooler swash plate engine (left), is controlled by a push button, and is shown together with a sectioned cylinder (right) from the Bristol "Centaurus."



Model of Clement Ader's " Eole " to a scale of 1 : 10. The aircraft, which was first tested in October, 1890, was claimed to have flown 50 metres.



In October, 1908, Cody made the first flight in this country, at Farnborough. His army aeroplane No. 1 is shown here in model form.



Press button exhibit, to show how a jet engine works. The complete sequence, including starting and speeding up the rotor, takes one minute.

Concrete Architecture in Scandinavia

Increased prefabrication and greater mechanisation on site are dominant trends, but without over-standardisation being evident. Lightweight concretes for insulation, exposed-aggregate concretes, and enamelled light metal sheets for curtain walls, are widely used.

Building techniques in Scandinavia are developing quickly, particularly in the use of mechanical equipment on site and of precast concrete sections. To see what progress is being made, a group of engineers and architects spent a week in September in Stockholm and Copenhagen on a visit organised by the Northern Ireland regional committee of the Prestressed Development Group.

In Stockholm the visit got off to a lively start with a tour of the new towns west of the city. The first of these, Vallingby, finished in 1957, is interesting both in comparison with British new towns and with other larger Swedish projects. As a planned suburb of Stockholm rather than a satellite town, the scheme includes blocks of flats in reinforced concrete built round a central *piazza* with shops, and with a railway station at the heart of the scheme. The effect is spacious and stimulating, livened up by some imaginative street furniture and shop-signs, cool splashing fountains and cobbled paving in circular patterns.

The neighbouring town of Hasselby and housing schemes at Grimsta under construction demonstrated the dominant trend in modern Swedish building techniques—increased prefabrication and greater mechanisation on the site. The results of these methods, so far as can be seen, do not seem to be over-standardisation or monotonous as one might expect. The domestic scale is rigorously observed, and the visitor seldom feels overpowered by sheer bulk. The buildings are often informally grouped on different levels for interest, bright with coloured cement renderings imaginatively used, and this year, at any rate, looked at their best with all the trimmings in place to flatter them—deep slanting shadows, sunblinds and flower-boxes.

PREFABRICATION

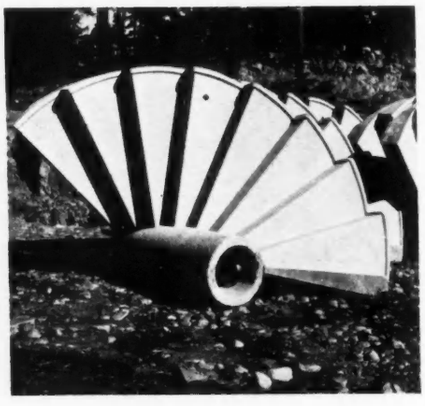
Later in the visit the group was shown a model of another ambitious housing scheme known as Farsta, which is just outside Stockholm. It will house about 30,000 people and include an extensive shopping centre now under construction. The various low-slab and high-point blocks will, for the most part, be constructed of precast concrete elements with prestressed concrete floor slabs. At the time of viewing, a series of spectacular precast columns, about 55 ft high and weighing 13 tons each, were already standing in the shopping centre like giant sentinels on a battlefield.

The group soon heard more about the trends of modern Swedish building construction from Dr. Mejse Jacobsson, who said that in the future less people would be working on building sites during the severe Swedish winters, and that this would obviously mean that more work would have to be done in factories. Prefabrication did not merely stop at beams, columns, wall panels and staircases: one enterprise had produced a unit comprising a complete bathroom, w.c. and part of a kitchen—the whole weighing 10 tons. Mr. Jacobsson also stressed the trend towards mechanisation and said that the group would notice during their visits to sites much activity with modern tower cranes, mobile cranes and hoists—as indeed they did. The new craftsman of the future, he said, who was skilled in handling mechanised methods was already emerging. Another interesting point made by Mr. Jacobsson concerned building materials, and he showed how the use of lightweight concrete had increased enormously during the last 10 years and, at the present rate, might soon overtake more traditional materials.

Later, the group went to look at Hotorget, the new centre of Stockholm where five 17-storey office blocks are going up. One of these is nearly complete, and the second nearing completion. The blocks have mostly reinforced concrete frames, chosen for economical reasons, with some smart curtain walls of aluminium and pine-green enamelled light metal sheets. The blocks tower above an attractive *piazza* with a market surrounded by low-storey shops and open-air cafes.

Together with the centre of Hotoget, there is in the city itself the highest building so far planned in Sweden, intended for the income-tax offices for the city of Stockholm. It is 26 storeys high, and smooth faced with a light blue-grey curtain wall similarly detailed to Hotoget. The frame is of reinforced concrete and all the ceiling soffits are of exposed concrete, with no plastering to the lightweight concrete partition walls.

In much evidence was that ubiquitous lightweight concrete material "Siporex," which managed to put in an appearance on nearly every project visited. The material originated in Sweden some years ago, and has since enjoyed great popularity both for internal partitions and as an insulator in external walls. All things being considered, it is not really surprising that this strong, cellular, semi-structural material should have caught on in insulation-conscious Sweden. It also possesses the advantage of obviating plaster-work—it need only be sprayed with sand-putty and paint, or papered (wallpaper was also seen applied to unplastered ordinary concrete walls). Of the same family, there is also "Ytong," another lightweight concrete material used extensively in housing schemes.



Precast concrete stair units, now used frequently in Sweden.

The Tre Falke centre, Copenhagen, contains a hotel, conference hall, theatre, cinema and shops.

The emphasis on prefabrication and mechanised methods was strikingly demonstrated at Nasbydal, where seven 17-storey blocks of flats were being erected by a method known as the "Skarne" system. With this method an *in situ* concrete tower is first constructed to form the central core of each block and contains all lifts, stairs and services. A tower crane is then erected on top of the tower, and the remaining load-bearing internal concrete walls and floors placed around the core. Finally, the building is clad according to taste—in this instance with a sandwich wall of mineral-wool slabs faced with aluminium.

CONCRETE FINISHES

Another widely used method of construction, known as the "all-concrete method," was also seen on a housing scheme at Edsberg. The system was introduced in 1952, since when about 4,500 flats have been built with it. There is nothing particularly new about the method—it consists of *in situ* reinforced concrete cross-wall construction with storey-high precast outer wall panels having an exposed aggregate finish. The system has been used to great effect on a number of well-detailed multi-storey blocks.

A number of individual major buildings were also visited, including a domestic training school at Fridhemsplan. The outstanding feature about this building was the exceptionally high standard of concrete finish both in the assembly hall, where all the concrete had a board-marked finish of a quality not often matched elsewhere, and on the 13-storey tower block which was faced with well-detailed precast concrete panels.

At the new intercontinental Arlanda airport, in the forests north of Stockholm, the group saw under construction the main building consisting of a five-storey central block of *in situ* concrete with hangar roofs cantilevered from either side. The hangars will accommodate four jet planes such as the Douglas DC-8, and have walls and roofs of Siporex slabs. Besides the main building, a section of the two-mile concrete runway was seen under construction, with the sand and aggregate quarries on site.

In Denmark, the group had as their guides members of the Danish Cement Works and the Danish Building Centre. In Copenhagen, as in most capital cities these days, a "skyscraper" or two already lend drama to the townscape, and Arne Jacobsen's smooth SAS hotel and air terminal looks graciously down over the city centre and Tivoli gardens. The building is a light grey-green slab of curtain walling around 21 storeys of *in situ* reinforced concrete. This tall block is set on a two-storey podium, similarly faced containing the reception rooms. The total effect is superbly simple and light. Nearby, the cigar-shaped plan of Ole Hagan's 18-storey Codan building rises as a vigorous tower faced with mosaic. The building is much heavier in feeling than the SAS building, but nevertheless looks interesting even at this comparatively early stage of construction. Another project still under construction in the city is the new Byggecentrum (Building Centre); it is only half finished as yet, but already promises a fine arrangement of exhibition and display, areas housed in an elegant concrete structure which employs thin precast load-bearing mullions.

Outside the city centre, the party was driven through countryside closely resembling Cambridgeshire, where groups of multi-storey blocks of flats are sited around the new towns of Milestetdet and Nygardsparken. Textured concrete has been used effectively on these blocks, both on gable walls and balcony fronts. Generally the texture has been applied to precast slabs with deeply recessed patterns bold enough to lend interest to otherwise blank concrete surfaces.

SPIRAL ANCHORAGES FOR PRESTRESSED CONCRETE

A new pattern of anchor grip for prestressed concrete has been introduced by Cable Covers Limited, St. Stephen's House, London, SW1. The anchorage is a casting with a deep spiral flange around the body, as shown in the illustrations. With good compaction of the concrete the spiral gives an even distribution of the load into the body of the prestressed member.

The company are now operating four post-tensioning systems, two for use with wire and two with large diameter strand. In the spiral wire system, the cable comprises either 8 or 12 wires of 0·276 in diameter, separated by polystyrene spacers, and each wire is stressed separately. The anchorages are shown in Fig. 1. They are 7 in long castings of Meehanite, with a back bearing plate 4¾ in square. The spiral flange is set at an angle of 80° to the axis of the cable to form a continuous abutment along the full length of the anchorage. Tapped holes in the back of the casting make for easier fixing of the anchorage to formwork, and the nose of the casting is angled to simplify the location and taping of Python sheathing.

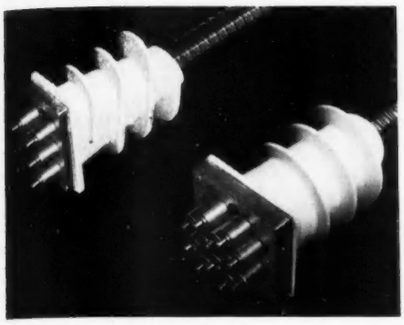


Fig. 1 Spiral anchorages for wire.

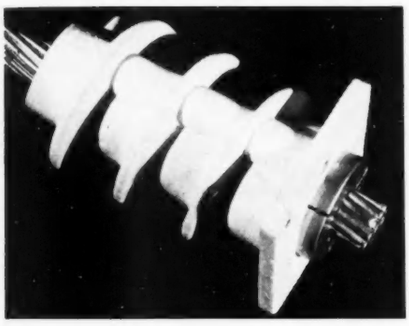


Fig. 2 Spiral anchorage for 1⅛ in strand.

Fig. 2 shows the anchorage for the CCL spiral strand system; it possesses the same features as the wire anchor. The block can be cast into the concrete leaving only a small portion of wedge protruding after stressing. Grout holes and tapped fixing holes are provided and the only loose part is the wedge.

The other two systems are the standard wire system which has been widely used and is suitable when the size of the anchor plate is not critical; the standard strand system is an alternative for the spiral strand anchorage if the block is not set into the concrete. In addition, the company also offers a range of jacks for each of the different systems. In the case of the large diameter strand, stretching is not a good enough guide to the induced load and the company have developed (in association with Philips) a load cell and strain gauge meter.

Success of Steel Bridge Competition

The winning entries have been announced in the $44,000 state highway bridge design competition sponsored by the United States Steel's American bridge division. Top winner in the professional class was Allan M. Beesing, a structural design engineer with James J. MacDonald, Buffalo, New York. He receives $15,000 for his entry.

Conducted under the auspices of the American Institute of Steel Construction, the competition was for a steel bridge to carry a two-lane cross-road over a modern four-lane highway. This problem was chosen as being especially appropriate to the construction of America's 41,000 mile international state and defence highway system over the next 15 years. It is estimated that more than one bridge will be required for every mile of the high-speed highway network.

The competition ran from 5 September, 1958, to 31 May, 1959. An even 300 entries were received from 264 professional engineers and another 36 from students; 200 came from within the United States and the others from 28 foreign countries. Four of the 15 awards were made for foreign entries, two from students and two from professional engineers. One of the awards, valued at $1,000, was won by a joint entry by Michael and David Brunt, of Ashton Clinton, England.

Their design was for a single-span arch of welded steel girders that bridged the highway without a centre supporting pier. By adopting a continuous girder system and using composite T-beam action, the designers achieved a low depth-span ratio which, combined with slender columns, gave an impression of structural lightness. The structure is statically indeterminate in the first degree and, for its solution, the designers used the virtual work principle. All the inclined members are fixed to the horizontals by pins. In addition to good appearance the designers gave as reasons for their choice of structure the ability to absorb differential settlement of the fundations; and economy of site work by prefabrication of the whole superstructure, so speeding erection and saving cost.

Mr. Michael Brunt is currently on the staff of the county surveyor, Buckinghamshire, and Mr. David Brunt is with Ove Arup and Partners of London.

Potable Water in the Desert

Two North African sites—one a hospital in Tobruk, the other the city of Zarzis in Southern Tunisia—will soon obtain potable water from saline desert wells. In both cases, electrodialysis plant is being installed by Ionics Incorporated, of Cambridge, Mass, USA; the projects are being financed by the International Cooperation Administration.

In Tobruk the unit is for a United States hospital being built by the Libyan-American joint public health services. The unit will provide 5,000 gallons of good drinking water everyday from a local well containing 0·4 per cent of mineral salts (about one-ninth of the concentration of seawater).

Zarzis, on the Tunisian coast near the Libyan border, is a city with a population of 10,000 which is being developed as a holiday resort for Europeans. At present drinking water is hauled 50 miles to Zarzis by tanker at an estimated cost of $10 per 1,000 gallons. With the new plant in operation the cost is estimated to be $1·60 per 1,000 gallons, despite the high cost of electricity at the site. Current will be taken from the nearby generating station that already serves the city and the water will be distributed by public works department of Tunisia.

A considerable number of water purification plants, working either on the electric membrane or distillation principles, have now been installed in the Middle East by British or American concerns. Primary users are the oil companies but other industrial as well as municipal users are establishing such plant to convert local waters.

Major Works in Hull Docks

Improvements valued at £4¾ million have been authorised at King George Dock, Hull, by the British Transport Commission. The work will include extensions to three quays and the provision of more transit sheds, cranes, grain elevators and silo accommodation. More than £1½ million has been spent on the Dock in recent years. It is now capable of admitting on all tides vessels drawing up to 27 ft.

To obtain access for larger ocean-going cargo ships, the Commission have initiated a hydrographic survey of the dock entrance with a view to introducing measures that would enable the larger vessels to enter and leave on all tides. A possibility is the installation of impounding pumps that will transfer sufficient water from the river into the dock to raise the minimum level on the inner sill by about 4 ft.

The main work just authorised will be for the extension of No. 1 Quay by 2,500 ft to 3,700 ft by converting the existing echelon formation into a straight wharf and removing redundant coal handling machines. This will give simultaneous berthing for six of the largest ships using the dock. The work will also include the erection of four single-storey transit sheds with a combined floor area of 260,000 sq. ft and ten additional electric cranes, each of 6 tons capacity. This part of the project will cost around £2 million.

Underpass for the City of London

A major underpass scheme, costing nearly £4 million, is being considered by the City of London to enable road traffic to pass freely between Victoria Embankment and Queen Victoria Street. The tunnel would be constructed under road and railway bridge at Blackfriars, and the river wall will have to be rebuilt 150 ft forward of its existing position over a length of 250 yards. A second stage in the work would involve the further extension of the line of the river wall so that the underpass could carry traffic around Tower Hill and bypass the Bank junction.

The proposed underpass will have 16 ft 6 in headroom over dual 20 ft carriageways; with a 12 in central reservation and footways the total width will be 46 ft. Gradients at the entrance ramps work out at 1 in 40 and 1 in 75.

In view of the seriousness of traffic congestion in the area, parliamentary powers for the new works are to be sought next session for the first stage of the project. A request has also been made to the Department of Scientific and Industrial Research to investigate the effect on river currents of the proposed siting of the new river wall. The method of construction to be adopted will also have to be confirmed by the investigation.

Linking Asia with North America

A Russian engineer has put forward detailed plans for a 46 mile long dam across the Bering Straits between Asia and North America. It would be built by sinking Mulberry type pontoons across the straits. By the installation of extensive water control equipment to draw warm water from the Gulf Stream through the Arctic and into the Pacific, the project aims at improving the climate—and hence the agriculture—of the surrounding territories.

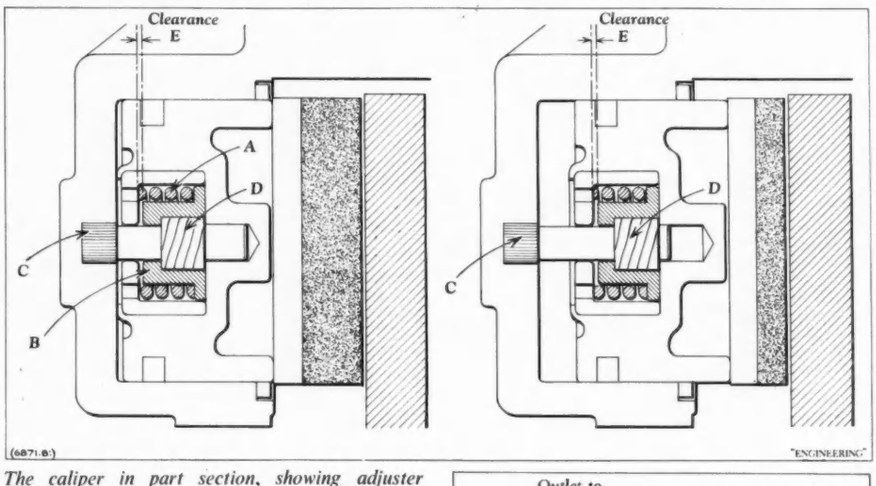
However, considered opinion is not convinced that, even if sufficiently powerful pumps were available, a measurable change could be made in the climate, nor is there any agreement on what direction the changes would take.

Brakes on the 1960 Models

By Gordon Wilkins

Disc brakes are being fitted on many types and makes of cars, but there are some notable exceptions in the luxury group. Pedal-operated parking brakes are finding favour on American cars.

The British disc brake, rapidly extending from the sports cars to the medium-priced family cars, is also beginning to make progress on the Continent. In France, Facel are offering the Dunlop as an option, and in Germany, BMW are fitting Dunlop discs at the front on their fastest saloon car, retaining drums at the rear, the first time this has been done with Dunlop discs. The German Dunlop company seems to be about to put discs into production and ATE are taking up the Lockheed disc. They have also evolved a design of their own with duplicated hydraulic lines, operating pistons and pads, but it seems doubtful whether manufacturers will accept the considerable increase in cost and unsprung weight for the very marginal increase in security over that which could be obtained by simply having separate master cylinders for front and rear brakes.



The caliper in part section, showing adjuster mechanism. A, compression spring. B, inner sleeve. C, post. D, close-coiled spring. E, clearance gap.

Now that Lockheed have got their disc brakes into production on several of the year's new models, there are three manufacturers, Dunlop, Girling and Lockheed competing for the brake business which was previously shared between the last two. They have all arrived at a broadly similar type of disc brake, with fixed calipers containing two operating pistons applying segment-shaped friction pads to each side of the disc. Dunlop and Lockheed use automatic adjusters to compensate for pad wear; Girling rely on the hydrostatic principle, using residual line pressure to keep the pads in constant light contact with the disc. On one or two heavy cars, a disconcerting phenomenon can be experienced with automatic adjusters. When cornering very fast, the cumulative effect of clearances and deflections in bearings, steering and brake gear may displace the disc in relation to the caliper sufficiently to push the pads away from the disc. Next time the brakes are applied, most of the pedal travel is taken up in restoring the normal clearance, giving the impression of momentary brake failure. A second kick on the pedal restores normal operation.

The Lockheed brake has a cast iron caliper formed in two halves, held together by four ½ in bolts to a set torque loading. The two cylinders are connected by a cross bore, the junction of which at the mating faces is sealed by a rubber ring. This brake thus has no external bridge pipe joining the two cylinders and is claimed to be less vulnerable to damage by heavy stones in consequence. As there is no cutaway in the caliper, inspection for pad wear is a little more difficult than on some other designs, but much easier than on drum brakes.

The action of the automatic adjuster is shown in the cross-section diagram through a piston and pad. Hydraulic pressure moves the piston forward and compresses the coil spring A against the flange of the inner sleeve B, which is held stationary on the fixed post C by the friction spring D. When pressure is released, the coil spring returns the piston to its former position, with the clearance gap E fully open. As the lining wears, the clearance E will not be sufficient to cater for the increased piston travel. The piston will therefore move the whole adjuster mechanism along the post C to a new position against the action of the friction spring D. The coil spring will then open up the normal working clearance when pressure is released.

A device which gives a big improvement in braking efficiency for a small expenditure is one that has a spring-loaded valve in the hydraulic circuit. The valve closes off the hydraulic lines to the rear brakes when a predetermined pressure is reached and diverts all excess pressure to the front brakes, thus tending to prevent the rear wheels locking under the influence of forward weight transfer during heavy braking. Such a device was first employed on the Fiat-Baldwin drum brakes on the Fiat 1800 and 2100 and figures in the Lockheed disc-drum systems on the Wolseley 6/99, Austin A99 and BMC Miniminor.

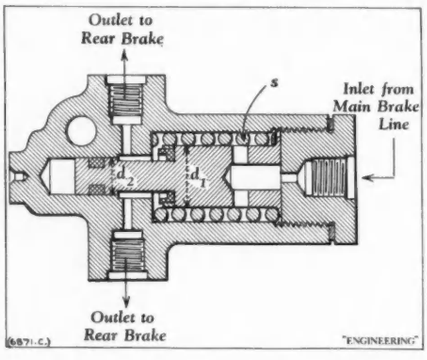
As the duty imposed on brakes in the United States is so much lighter than on European roads, American cars still look under-braked to European eyes, but General Motors are developing the drum brake within the tight framework of their production economics. After the radially finned aluminium drums with iron liners on the Buick, they are offering a new design on the Pontiac as an optional extra, in which the wheel is simply a rim bolted to the brake drum; this is a solution already seen on European light cars.

The Americans are switching over steadily to the pedal-operated parking brake with hand release for the ratchet, a feature used for years on the DS 19 Citroen. As so much more force can be exerted with the foot, this greatly increases its value as an auxiliary emergency brake. However, the Chevrolet Corvair has a large horizontal lever with a double action that enables the shoes to be tightened against the drums by a second pull when parking on a gradient.

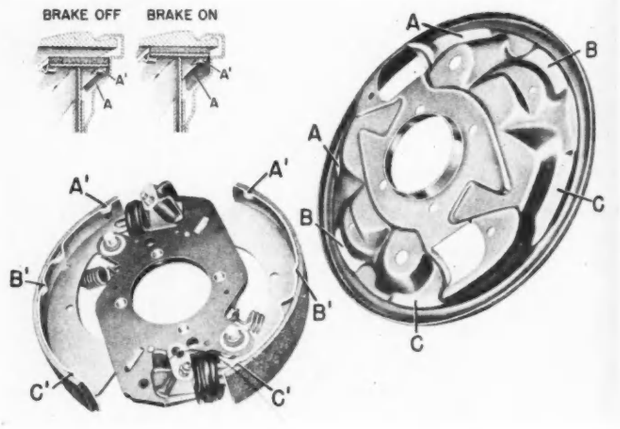
Chrysler Group cars for 1960 have what are called total-contact brakes. This rather misleading expression does not mean any increase over the normal lining area, such as is obtained with the four segments pivoted on two normal shoe webs in the Bentley Continental front brakes. It is rather a method of guiding the shoe more accurately. Kinks are pressed into the shoe behind the lining and bear against three platforms pressed in the back plate. These form guides which maintain accurate alignment between shoe and drum as the brakes are applied. Chrysler claim the brakes squeak less and can be adjusted to closer clearances, giving a greater reserve of pedal travel.

Among European makers of fast cars, Rolls-Royce, Bentley and Mercedes-Benz are prominent as having introduced new models which do not have disc brakes. Rolls-Royce repose justifiable faith in their drum brakes with mechanical servo, and two hydraulic circuits.

Mercedes-Benz continue to use alloy drums with radial fins at the front on the new 220 series. These brakes have shown a very high resistance to fade, but only when linings which are specially imported from the United States have been used.



(Above) The pressure limiting valve in section. Compression spring s holds the valve open against main line pressure until the pressure acting on the effective area d_1, overcomes the spring.



(Right) Three-platform total-contact brake (Chrysler).

Mergers Galore

The incidence of mergers between manufacturing companies in the engineering industry, and of the purchase of the smaller by the larger, appears greater now than it has been since the war. Among recent announcements is a merger between E.V. Industrials Limited and the Export Tool and Casehardening Company Limited. The principal advantages arising from this union are the familiar ones of " economies and greater efficiency," and the fuller use of the facilities available to both groups.

The Delta Metal Company Limited have acquired EP Jenks Limited and Alfred Case and Company Limited, thus providing themselves with greater strength in their own field and a useful broadening of their activities. EP Jenks manufacture water fittings and similar products, brass rod and wire, and copper tubes. The directors of Delta Metal commented that their association with EP Jenks " should lead to economies in production which will not only benefit ourselves but also our customers, and at the same time help to strengthen our industry against foreign competition." Alfred Case are engaged in the manufacture of rolled metal, as are Delta's subsidiary Earle, Bourne. In this case the acquisition will enable Earle Borne to expand " without the necessity of incurring substantial capital expenditure which from the point of view of the country as a whole, would have meant unnecessary duplication " and also the fuller employment of their available plant.

The third of these latest mergers involves an American company. U.S. Industries Incorporated (Great Britain) have purchased for cash the Burtonwood Engineering Company of Burtonwood near Warrington, for " several million dollars." Burtonwood Engineering are mainly concerned with the production of oil well equipment, precision machinery for the plastics industry, oil seals, and engine reconditioning. The company, whose turnover is some $160 million a year, expect Burtonwood's own turnover —£1·25 million—to be doubled in 18 months under the new arrangements. Mr. John I. Snyder, Jnr., chairman of U.S. Industries (Great Britain) said that the company would concentrate on the North African oil market, which he felt was ready to " bust wide open."

Pye in the Commonwealth

The expansion of Pye Limited is being pursued on the basis of increased investments in the Commonwealth. Their chairman, Mr. C. O. Stanley, told the company's shareholders that the future of the free trade area has convinced the board, " more than anything else could have done," that this policy is " entirely right " and should be pursued " with even greater vigour." The emphasis is on the long-term earning potential of the investments and for this reason it is the company's policy to encourage local citizens to share in the investment. Mr. Stanley said that the latest production methods are being introduced and that new factories are either being built or being planned. Of these two are in Australia, one in New Zealand, one in Ireland and four or five in the United Kingdom. In Australia, Pye have invested heavily in Electronic Industries Limited, which is one of the leading companies in the country.

Another definite trend in Pye's development is towards diversification to enable them to become " less and less dependant on purely consumer goods." During the past three years this policy of broadening the base of activities was carried out with long-term benefits in view and at the expense of current profits in those years. Mr. Stanley expects that, unless there is a sudden change in the trading climate during the remainder of the year, shareholders should be able to see " tangible evidence of the rewards to come from this ploughing of new ground," much of which has consisted of investment in new forms of electronic development and further extension in the instrument field.

AEI Demonstrates

A series of exhibitions and demonstrations of welding equipment has been planned by Associated Electrical Industries Limited, to be held in various centres of industry. The Heating and Welding Department of the AEI Transformer Division, who are organising the campaign, held their first show in Newcastle upon Tyne during the first three days of September, on the premises of the Rutherford College of Technology. It has now been repeated in Birmingham (in the Midlands Electricity Board showrooms, Aston) from 19 to 30 October.

The exhibits include resistance welders (air operated, spot, projection and butt types) and arc welders. An automatic arc welding machine suitable for either open or submerged arc welding, have been demonstrated using the submerged arc process.

Single and multiple-operator a.c. welding sets, rectifier arc welding sets and inert-gas arc welding equipment have also been shown. Associated equipment included a rope parting machine and a rivet heating machine. Using the a.c. " Thermac " welding set and the d.c. rectifier unit, test runs have been made using various Metrovick electrodes.

Kaiser in Britain

The third largest aluminium producers in the United States, Kaiser Aluminium, have formed a private company in Britain with a capital of £100. The other two large US aluminium producers are already operating in this country. The first to come in was Reynolds Metals through their agreement to operate and develop the aluminium interests of Tube Investments on the basis of joint ownership. Subsequently Reynolds TI acquired control of British Aluminium and more recently extended their interests by purchasing the aluminium foil division of Venesta. The largest aluminium producers in the US, the Aluminium Company of America (ALCOA) linked up with Imperial Chemical Industries in June.

Kaiser Aluminium, who developed rapidly after the war with the help of large Government contracts, have done little so far in Britain beyond supplying ingots to the manufacturers of castings, forgings, sheet and extrusions. They are themselves large manufacturers of these products in the US and can be expected to set up adequate processing facilities in this country. It is also likely that they will provide themselves with ingot making capacity since the key to economic manufacture of aluminium products is a fully integrated plant or chain of plants.

Setback for Cammell Laird

The persistent labour disputes which have prevailed for so long in the shipyards and works of Cammell Laird and Company have proved more costly than had been anticipated. The company's interim statement just published indicates that inter-union disputes have affected the operations of the Patent Shaft Steel works as well as the shipbuilding activities. Difficulties have been experienced in bringing new plant into production and so far the works have failed to operate at a profit. Shareholders are warned that they must expect a further reduction in group profits in 1959 and the interim dividend is cut from 4 per cent to 3 per cent.

The company's directors are clearly reluctant to say anything binding about the overall trading position at this stage. They face difficult conditions in the shipbuilding industry and have probably fared worse in this respect than some of the other leading shipbuilders due to the repeated delays in deliveries imposed by unofficia strikes. There has, however, been some improvement in the order book position of Patent Shaft and there is hope of better results from this quarter in the future.

Enterprise in the Philippines

The growing potential of manufacturing industry in the Philippines has been vigorously exploited for some years by the more far sighted of America's industrialists. More recently some British firms have joined in and one of these, Thomas Robinson and Son Limited, have supplied and erected a complete flour mill in Manila, the first to be set up in the country. The mill has an output of 17,250 lb per hour and the equipment and machinery which was supplied by Robinsons in the face of severe competition, was valued at nearly $1 million. Robinsons also had to contend with powerful American exporting interests fighting to retain their foothold in what represents the second largest flour importing market in the world.

With the successful completion and operation of this first mill, the recently formed company, Republic Flour Mills Incorporated, which has established this new industry in the Philippines, placed a repeat order worth $750,000 with Robinsons for an additional mill. This will step-up the mill's output of flour from the present 17,250 lb per hour to over 31,000 lb per hour. This has proved to be the most comprehensive project yet undertaken by a firm of flour milling engineers. Before the project commenced, Republic Flour Mills Incorporated employed the Robinson engineering consulting service to advise them in obtaining the most suitable site for the new mill, and also to plan the site to the optimum advantage to make this project the most modern of its kind in the world. In this way Robinsons not only provided the equipment for the mill but also supplied advice and service on all aspects of the enterprise from its conception.

The manner in which Robinsons operated is indicative of what is required of plant suppliers to a country such as the Philippines. Another requirement is long-term finance but the investment would appear to be both secure and reasonably profitable.

Rootes and Rover

Enough has already been announced to make it very clear indeed that British car manufacturers have had a most prosperous time since the last show was held. We commented last week on the wonderful results obtained by Ford, traditionally (since the war) the most successful in the industry. Now the results of two of the smaller firms have been published and are consistent with the most optimistic views expressed by the industry during the past twelve months.

Rootes Limited increased their profits from £3·48 million in 1957/58 (year ended 31 July) to £5·34 million. This startling increase takes the figures well beyond the level of the 1955 boom. No production figures are given but it is obvious from the profit figures that the improvement has been spread right through the group—even Singer making a very worthwhile contribution (£446,000 odd) for the first time since its acquisition. The heavy calls on liquid resources likely to develop over the next few years for the purpose of expansion were probably responsible for the directors' decision to raise the company's dividend only from 8 to 12 per cent.

A different picture is presented by the performance of the Rover Company. Profits have risen modestly by 6·75 per cent to £1·9 million, but the dividend has been raised from 22½ to 27 per cent. A feature of the post-war development for this company has been the extraordinary stability of group profits. Resolutions to increase the authorised capital to £4·5 million and to approve a 1 for 1 scrip issue will be submitted to the annual meeting next December.

Design for an Ocean Going Research Ship

There is an urgent need for a comprehensive ocean-going research ship that can remain at sea for months at a time and undertake a wide range of research projects simultaneously. Canada, the USA and UNESCO as well as the UK are examining plans for such a vessel.

By H. F. P. Herdman, D.Sc.

National Institute of Oceanography

It is a sobering thought to realise that, as a maritime nation we probably know less about what is in, or under, the sea than we do about outer space, and yet we are still largely dependent on the sea for our livelihood. Man has sailed the waters of the globe for several thousand years; even so, our knowledge of the surface of the oceans is pitifully small. Every year 300 ships sink from one cause or another and many more are damaged or delayed, mainly by wave action.

Marine scientists work under several major disadvantages. The first is the disparity between the size of the oceans (they cover an area more than twice that of the land surfaces of the earth) and the number of oceanographers. A second relates to the inability to see what their apparatus is doing under the surface of the sea. In addition, there is the limitation imposed by the ever changing conditions in the sea and their as yet unpredictable variation with time and place. Some of these variations, but not by any means all, may be due to seasonal changes and they can only be studied in places accessible to research ships. Few of these exist which are large enough to be capable of the long-range work involved, and few oceanographic laboratories or institutes have sufficient trained staff to man them.

Nevertheless, much progress is being made. We are beginning to understand how the wind causes waves and to study their effect on ship movements. Wave recorders are now available to help engineers plan harbour defences, and for fitting in ships. Instruments have been developed for measuring currents at all depths and progress has been made in studying the problems of oceanic circulation—on which the fluctuations of the fish population of the oceans so much depends. These major advances towards resolving the more fundamental problems facing the oceanographer have not been made without their attendant difficulties. Of these, not the least has been the necessity to show that this research is, or can be, of practical advantage to the sailor, harbour engineer, economist and others.

SCOPE OF REQUIREMENTS

This advance of oceanography in recent years has shown the need for vessels capable of undertaking extensive work in any branch of oceanography on a world basis in almost any weather, and the more specialised approach to a number of problems, coupled with the ever increasing use of electronic equipment, makes a demand on ship space which is not easy to satisfy in a small ship. Before the Second World War marine physics (then known as physical oceanography) was confined largely to routine sampling of the sea with simple instruments and the analysis of the samples by conventional methods. The laboratory space required was relatively small and it was not necessary to carry a large highly-specialised staff. Now, in addition to a certain amount of conventional sampling and analysis still necessary, the ability to make routine examinations of the ocean bed by means of echo sounders, coring tubes and deep-sea cameras, the measurement of currents at all depths by electronic devices, the study of sea and wave motion, and the relationship of these to the atmosphere, demands a complexity of instrumentation not only in the sea but in the ship as well. It also demands a team of specialists to use and maintain the instruments. The development of underwater acoustics for fish detection (in conjunction with an electronic scanner), and bottom survey in shallow depths, adds to the problems of space for instruments.

In marine biology, modern techniques have also had their effect. The study of the fertility of ocean waters has brought more instrumentation in its train; the carbon-14 method of measuring photosynthesis, for instance, requiring a considerable set-up of apparatus. The deep-sea camera has been adapted to photograph living animals and a flow meter and telemetering depth recorder devised to measure the volume of water passing through a plankton net and the depth of operation. Generally, however, the demand for increased laboratory space is considerably less than for marine physics, though the marine physiologist often takes more electronics to sea than the physicist.

To comply with Ministry of Transport requirements, an ocean-going research ship registered in Great Britain must attain a high standard of accommodation and amenities for officers and crew. In a small ship these requirements conflict rather with the demand for well-sited laboratories and the space necessary for handling complicated equipment. Some form of compromise can usually be effected, at the expense of either science or personnel, though it is often the former which suffers.

Another very important point which must be considered in designing a new research ship is the number of scientists available to man her. With modern instrumentation, a much higher degree of specialisation is necessary and on an extended cruise of some months a large scientific and technical staff will be required to cope with the various aspects of the work. One must remember, of course, that however large or small the ship, only a limited number of observations can be made at any one time; nevertheless when the ship is making an extended cruise far from base (such as the projected oceanographical survey of the Indian Ocean) she has to be ready to do all kinds of work, and there is often much advantage in teams with differing outlooks working side by side.

There is generally some difficulty in staffing a large research ship and arranging the various programmes, and it may be asked why a smaller ship would not serve the same purpose. There are several good reasons for the larger ship; in the first instance modern oceanographic instrumentation requires much more laboratory and deck space than hitherto, as well as more scientists and technicians to maintain it and if the ship is to serve all branches of oceanography, adequate facilities must be given to each branch. Very few existing research ships meet this need. Fishery research ships are usually built on the lines of an ocean-going trawler and although marine biologists know the importance of studying the physical aspects of the ocean, e.g., the water movements, which influence the distribution of the fauna, and the concentration of nutrient salts, the presence or absence of which is an important factor in their growth, physical oceanography is, of necessity, subordinated to the use of a full-sized commercial otter trawl and facilities for handling and sorting the catch. In other small research vessels, laboratory facilities for the marine biologist often are almost non-existent. Finally, in a small ship or in one with laboratory space inadequate to present needs, much time and energy is expended between cruises in removing one set of scientific equipment and replacing it with the apparatus for the next cruise. Much of this work could be avoided if the laboratories were big enough to house permanently all but experimental apparatus.

Many research ships are used only for collecting, i.e., they are too small to have adequate laboratory facilities for accurate chemical and biological analysis. For this reason and others they must work within reasonably close range of their base. As mentioned earlier, plans are being made for a large-scale international investigation of the Indian Ocean. Most of the ships taking part will be small, and will have to work far from their normal base—thus severely curtailing their activities.

The USSR has recognised the need for bigger vessels by building very large research ships, three of which figured prominently in the oceanographical programme of the International Geophysical Year.

There is also the advantage that a large ship will form a reasonably stable working "platform," and so make it possible to do much work not usually attempted as a routine on board a ship. Very adequate laboratory space for each branch and good facilities for the immediate processing of data are, for example, available on board the USSR Mikhail Lomonosov (6,000 tons displacement).

OPTIMUM SHIP SIZE

Much thought has been given, not only in this country but also in the United States of America, and by UNESCO, to the design of a comprehensive ocean-going research ship. There is a considerable divergency of opinion on many points, especially on size, and methods of propulsion, but all are agreed on a considerable increase in the space to be allocated to science. This increase cannot be made at the expense of crew accommodation or, indeed, of the accommodation for the scientific staff, and so a larger ship becomes a necessity not a luxury.

The reluctance of most countries to build large research ships stems from a variety of causes. It may be from the high cost of building, running and of maintenance; it may be thought also that a large ship will require a very large scientific and technical team and, in addition, there is the feeling that the absence of a low freeboard will make it more difficult, or even impossible, to handle certain overside equipment. This latter is likely to be true if a ship of 5,000 to 6,000 tons displacement is envisaged, but a vessel of this size seems unduly large—just as the upper limit set by some American oceanographers (about 1,000 tons) seems unduly small. Differing ways of life in the Old and New Worlds no doubt favour the smaller ship. A single cafeteria mess for all hands obviously is more economical of space, as are multiple-berth cabins, and an ample supply of student labour, who can be accommodated in bulk, certainly reduces living space, if not crew, though the 50 : 50 ratio of scientists to crew, as envisaged for the 180 ft vessels advocated in the USA would, perhaps, be a little difficult to achieve in a truly ocean-going ship manned outside that country.

For a ship to be used on a full international basis it seems likely that a more conventional arrangement of accommodation is desirable. Against all this must be set the fact, however, that two or possibly more small ships may be required to do—perhaps with difficulty and certainly under more unpleasant and cramped conditions—what one bigger ship can do easily. More scientists, proportionally, would also be required to man the smaller ships. A further argument in favour of an increased size of ship is her ability to keep the sea in all weathers and often to work under conditions which would

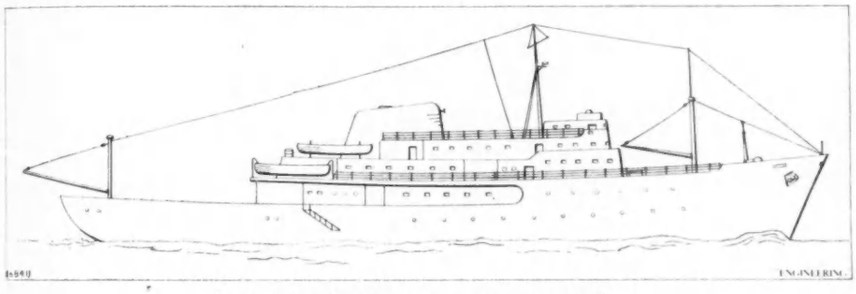
keep a small ship in harbour. The advantages of being on the spot and ready to start work when the weather improves are inestimable, and have been proved time and time again in the Royal Research Ship Discovery II. Her dimensions are: length (over all) 234 ft, moulded breadth 36 ft, and depth 20 ft, with a displacement of 2,100 tons. The ratio of scientists to crew in Discovery II (10 : 40) is low by American standards but it is reasonable for a deep-water, all-purpose research ship, capable of working for months, even years, away from home, and with a resident team of fully-qualified scientists, whereas some research ships are little more than offshore laboratories.

It would be very difficult in most countries to find enough fully-qualified scientists to give an equal ratio with the crew; on this basis, scientific assistants, technicians and students not only must form the bulk of the scientific staff but also take over some crew duties, and most of the routine work of handling heavy deep-sea equipment, and maintaining the ship, is probably much better done by the fewer professional seamen of a permanent crew.

The larger ship will entail a much larger bill for crew, but above a certain size this is not necessarily so—for example a reasonable increase in size over that of the Discovery II, say to an overall length of 250 ft, with a beam of 42 ft, should not require any more deck officers, Petty Officers and ratings than are now carried. The complement of engineer officers and ratings will depend largely on the method of propulsion. Steam, whether driving triple-expansion engines, or powering turbo-electric drive, should not require an increased engine-room staff, unless it is thought desirable with the latter method to carry an electrical officer. If, on the other hand, diesel-electric propulsion is used there will be a distinct reduction. As with turbo-electric drive, one additional electrical officer may be necessary, but six firemen would be replaced by three greasers.

To sum up, the field of marine research has enlarged very greatly in the last quarter century and this growth is much more than a mere academic expansion. It results from the effort to meet the insistent demand for information, and the further problems which continually reveal themselves point to continued expansion.

The oceans of the world are a vast field of operation and if a single ship is to be capable of all types of research in such a field, then a vessel larger than the Discovery II will undoubtedly be needed for the task.



Suggested profile of an ocean-going research ship.

RANGE, ENDURANCE AND SPEED

The ability to keep the seas for a reasonably long time is an important requirement for an oceanic research vessel. Fuel and water must be adequate for a minimum period of at least four to six weeks away from port, bearing in mind that to manoeuvre the ship on "station" consumes nearly as much fuel as straightforward steaming. Taking an average of four years, Discovery II has spent nearly half her time at sea on station. For a long-range ship the bunker capacity should therefore be sufficient for a range of 12,000 to 15,000 miles, to include work on station. An economic speed of 9 to 10 knots is desirable, and quite adequate. The maximum speed should be about 13 knots.

It is not easy to give precise dimensions of a desirable size of research ship until a stage in planning has been reached when all scientific requirements have been met, the form of propulsion agreed and accommodation arranged to the latest standards. It seems likely, however, that a ship 250 ft in length (overall), with a beam of approximately 42 ft, and a moulded depth of 23 ft would meet all needs, certainly for some years to come. Compared with the Discovery II, these dimensions could increase the gross tonnage from 1,065 to, very approximately, 1,475 tons. It should be possible in a vessel of this size to have four working decks, including the boat deck.

The hull form of a long-range research vessel requires special consideration from the designer. Not only must emphasis be placed on seakindliness but it must also be directed towards the provision of a reasonably stable "platform" from which to work in all but the worst weather. This need for stabilisation is demanded mainly when the ship is hove-to or stopped, and making observations; it can probably be met by the provision of heeling tanks. Although desirable to have a stable ship when steaming it is doubtful whether the cost of fitting fin stabilisers, which only function when the ship is under way, would be justified. For handling certain types of apparatus a low freeboard is desirable, though not entirely necessary. The large research ships of the USSR do not have a low freeboard and yet manage to handle deep-sea marker buoys and similar gear.

PROPULSION AND MANOEUVRABILITY

A major problem in the design of a research ship is the type of propulsion to be adopted. There are many points to be considered and among these are weight, economy of space, both for engines and fuel, but more especially the latter, since auxiliary generating sets have to be accommodated, absence of vibration and noise,* a minimum of maintenance costs and, by no means the least requirement, the ability to steam at speeds as low as 1 to 1½ knots. In addition, for manoeuvring on scientific station, bridge control of the main propulsion unit or units is highly desirable. Types of machinery available range from the simple triple-expansion engine to the gas-turbine and, possibly, atomic energy.

If only the considerations were economy in space and fuel consumption then direct diesel or diesel-electric drive would meet these needs. For slow running, flexible control and manoeuvrability direct diesel drive is hardly flexible enough, nor does it allow of very slow running. This difficulty might be overcome by the use of a controllable-pitch propeller, but experience with these is still rather limited and it seems that the well-tried system of diesel-electric propulsion would be more satisfactory in these respects; either system also lends itself to a satisfactory type of control from the bridge. When we come to consider absence of vibration and noise, either form of diesel propulsion has grave disadvantages, especially with regard to noise. The problems of vibration in the smaller medium-speed marine diesel engines has largely been solved but it is not easy to confine the noise to the engine room nor, in a long-range research ship, where engine-room workshop facilities are a necessity, is it desirable so to do.

If space is available—not so much for the machinery as for fuel—then turbo-electric drive would meet the demand for quiet running. Less space is required for engine and boiler rooms than for triple-expansion engines, but for long-range work considerable space must be allocated to bunkers. For a very small ship such a sacrifice cannot usually be made, but in a long-range research vessel there should be adequate space below the waterline, and otherwise unusable, in which to carry ample fuel. So far as maintenance is concerned this is likely to be much less with turbine than with diesel machinery.

So far it has been assumed that single-screw propulsion is envisaged. This has disadvantages when the ability to manoeuvre quickly, so essential in a research ship, is considered but the initial cost is lower and fuel consumption is less, thus giving a longer range. Apart from this, twin screws are apt to foul scientific gear and instruments lowered at or near the stern and if navigation in ice is required they can be a danger. Other methods are now available for increasing the manoeuvring power of ships. These include the Voith-Schneider propeller, which can be used as the main form of propulsion, or fitted in a duct in the bows, the "Active" rudder, in which a rudder with a built-in electrically-driven propeller replaces the ordinary rudder and jet propulsion units, also fitted in a bow duct. For simplicity of machinery and freedom from maintenance it would seem that these latter units would be the most satisfactory.

LABORATORIES, WORKSHOPS AND STORES

Sub-division of the spaces allocated for laboratories into a number of smaller units is preferred in this country, and also in the USSR. The extent of this sub-division depends, of course, on the size of the ship and in the USSR Mikhail Lomonosov separate laboratories have been provided even for closely allied branches of physical oceanography. For the size of the vessel now under review a reasonable "breakdown" of space would be as follows:

Boat deck.—Library and writing room, with "light" table and survey chart room (additional to ship's chart room) with very large plotting table.

Upper deck.—General laboratory (adaptable to either biological or certain physical needs), chemical laboratory, electronics laboratory (with associated workshop facilities) and a "wet," or rough, deck laboratory, adjacent to the forward deep water-bottle winch, for handling and storing water-bottles, thermometers, etc. A ready-use electronics and general scientific store should be sited near the main laboratories.

Main deck.—"Wet" biological and general rough laboratory near the net winches. Net room and store adjoining the scientific workshop (with lathe, drilling machine, etc.) aft near trawl winch, and scientific office. This latter could be combined with a further ready-use store. A small battery room on this deck would be an additional advantage.

Lower deck.—Photographic laboratory and darkroom, low temperature laboratory, and underwater instrument room (Asdic, shipborne wave recorder).

Hold.—Store space aft at hold level, with large hatch on after deck and additional access under cover on lower deck should be capable of accommodating all bulky equipment. In addition, space should be available, either on the boat or upper decks, for siting a "package" laboratory, such as are commonly used by American oceanographers. These are, in effect.

* Fourastié (*Machinism et Bien-être*, Ed. de Minuit, Paris, 1951) has said (p. 199) "Silence is almost as essential as light to intellectual activity."

portable laboratories which are fitted out ashore with all instruments ready for use and are then hoisted on board, secured and connected to all main services.

Omitting hold space, the laboratories, workshops and associated scientific spaces should occupy a total area of not less than 2,100 sq. ft. Services to laboratories in general should include d.c. and a.c. power (this latter at 230 volts, 50 cycles), fresh and salt water, vacuum and compressed air connections. All main laboratories should be air-conditioned. The chemical laboratory will house the salinometer and should have an electric still for distilled water. Permanent post office type instrument racks should be fitted in the electronics laboratory and workshop. In all other laboratories arrangements should be made for fitting these racks if the occasion arises. All laboratory doors, and doors leading out on deck must be as large as is practicable, in order to save dismantling complicated gear coming to or leaving the ship.

DECK ARRANGEMENTS

Adequate deck space for all types of work and freedom from unnecessary obstructions are essential needs. Masts should be of tripod construction thus doing away with rigging. Derrick posts should, if possible, be self-supporting, or with a minimum of stays. If the latter are necessary they should not obstruct the passage of long and probably unwieldy instruments overboard. The cantilever system of supporting bridge wings and overhanging decks should be used to obviate the need for supporting stanchions along the ship's side. Forward, at least 60 to 70 ft clear of all obstructions is required for handling coring tubes and equipment. Aft, for mid-water trawling and deep net operation generally, there must be a clear deck abaft the superstructure for a minimum of 60 ft. And on one side amidships there must be sufficient space around small oceanographical winches to allow freedom of movement, both for operators and apparatus. Derricks, forward and aft, for handling coring gear and trawling equipment should not be sited amidships. Two derricks at each position, on opposite sides of the ship, are much preferred to one sited centrally. Forward and midships oceanographical winches should have associated A-frames, with shock-absorbing equipment, in lieu of the more usual davit, whereas the after oceanographical winch, used mainly for small vertical net observations, should have a " Discovery "-type davit. Wide roller fairleads, with large diameter rollers, should be fitted either side aft for handling large towed nets, dredges, etc., and one set each side of a modified form of trawling gallows are needed for use with the mid-water trawl. The hatch to the scientific hold aft should be sited as near to the ship's side as possible. There seems to be no reason—other than tradition—for a central position, which occupies valuable space. As already mentioned space is required on the boat or upper deck for a portable or " package " laboratory. Good deck lighting, by floodlight, is a necessity.

Deck winches for scientific use should comprise two heavy winches of approximately 75 to 100 h.p.; one forward for coring and similar bottom observations, the other aft for deep towed nets and dredging. Three small oceanographical winches, of approximately 10 to 12 h.p., are required for, respectively, water-sampling, vertical nets and for lowering instruments attached to small conductor-cored cables. The heavy winches should each accommodate 10,000 to 12,000 metres of tapered wire rope (16 to 13 mm diameter forward and 14 to 12 mm aft). The water-bottle winch (forward) should take 10,000 m of 4 mm steel wire cord and the vertical net winch (aft) 5,000 m of 6 mm steel wire cord. The remaining small winch (amidships) requires two drums, one to accommodate 10,000 to 12,000 m of 2 mm wire cord for buoy mooring, the other to take at least 3,000 m of conductor-cored cable 6 mm in diameter. To facilitate mid-water trawling it would be a great advantage if the heavy winch aft had three drums, the centre one for the long tapered warp and the wing drums each holding 2,500 m of 12 mm wire rope.

The type of power used to drive the small deck winches will depend largely on the type of propulsion chosen for the ship. If steam is available it is advisable that this should be used. On the other hand, the heavy winches would probably be, like most modern trawl winches, electrically powered.

NAVIGATION EQUIPMENT

The navigational equipment should include deep and shallow echo sounders, radar, Loran, Decca Navigator, electric log, gyro-compass and recording anemometer, a course and distance recorder in conjunction with the gyro-compass, rudder indicator and clear view screens. The ship's chartroom should be separate from the survey chart room adjacent to it. The latter should house the deep echo-sounding recorder, course and distance recorder and have space in which to fit, if necessary, the precision depth recorder. Also sited on the bridge should be a " talk-back " system of communication with essential parts of the ship, and a loud-hailer.

In the course of a decade consumption of electric current in the Discovery II has nearly trebled. This rate of increase largely reflects the difference between pre and post-war oceanography but is not likely to be sustained at this rate in the future. Nevertheless, there must be provision for future developments and a modern research ship should have a reserve exceeding her maximum output when built.

SHIP RESEARCH FACILITIES AT NPL

Some of Europes finest ship-testing equipment recently became available to the shipbuilders and naval architects of Britain when the new National Hydrodynamics Laboratory was officially opened by HRH the Duke of Edinburgh.

Forming part of the Ship Division of the National Physical Laboratory, these new facilities at Feltham, Middlesex, are not only believed to be the finest in Europe but they are said to " bear comparison with any in the world." The most noteworthy items are a 1,300 ft towing tank and a 44 in water tunnel.*

The dimensions of the towing tank (1,300 by 48 by 25 ft) give it many advantages. In the first place its length enables testing times to be reduced, because several different ship speeds can be simulated in one run along the tank. Also, larger models can be used, thus reducing the considerable difficulty of accurately making model propellers and at the same time reducing " scale-effects " on the measurements. The depth of the tank (25 ft) will enable tests to be carried out on submerged models of submarine cargo vessels—when this should become necessary.

The problem of propeller cavitation has become increasingly important in recent years and it may be in this respect that the new 44 in water tunnel will have its main use. Since propeller cavitation is critically dependent upon the exact geometry of the blades, the 24 in diameter models which the new tunnel will accommodate will contribute to greater accuracy of results and a better all-round understanding of the problem. Hydrofoils, rudders and stabilising fins are also subject to cavitation and the tunnel will have arrangements for studying and measuring the cavitation patterns and forces of such devices.

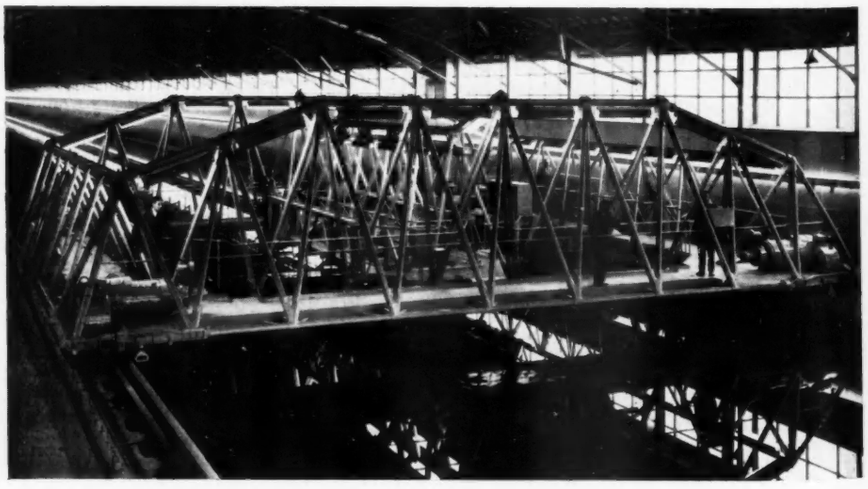
In addition to the head-on ship testing facilities of the towing tank, there is a 100 ft square sea-keeping basin in which remote-controlled models may be tested at any angle to the waves. At the moment the wave-making machine, which has been designed and constructed by Keelavite Hydraulics Limited of Coventry, works on only one side of the tank; later it is hoped that the machine may be adapted, or another one fitted, to create waves at right-angles so that complex seas may be simulated. The sea-keeping tank has two small docks for fitting and trimming models, which may be up to 10 ft in length. Data from the instruments in the models is either recorded or telemetered ashore.

One of the most difficult problems involved in the construction of the laboratory facilities was the accurate fixing of the carriage rails for the towing tank. This is of paramount importance because any irregularities in the track would give rise to changes of towing speed—thus invalidating any measurements taken on the model.

The type of rail used is a special section, weighing 260 lb per yard and of manganese steel. It has been designed to give suitable head dimensions for the carriage wheels and side-guide rollers and to have as uniform a mass and cooling area of head and base as possible. Rolled in 30 ft nominal lengths, the rail was stress relieved in a vertical gun-barrel furnace before being machined. The welding sequence included a post heat treatment for normalising the joints in the rails.

The main erection contractor for this, and most of the engineering plant at the laboratory, was Thos. W. Ward Limited, Sheffield.

The tank carriage is designed to tow ships' models of up to 5 tons in weight and 40 ft in length.



* A comprehensive technical description of the hydrodynamics laboratory, written by Dr. J. F. Allan who was then superintendent of the NPL Ship Division, was given in ENGINEERING, pp. 488–501, 19 April, 1957.

On the Shelf

By Frank H. Smith

I do like the type who rings you up at about a quarter to one with an inquiry, gives the impression that if he doesn't get the answer within minutes his life will be forefeit, and then when you ring him back is gone to lunch. In case the man I have in mind reads this (and I know he will) I am thinking of somebody who rang me up and asked how much a Viscount would cost. As if I'd know. But I did ring the aircraft sales of a Very Big Company to find out and there was no reply. They'd all gone to lunch. So that's a few thousand pounds they've lost. We columnists get a bit shirty when we can't buy an aeroplane when we want one.

For those who are a bit puzzled about the set-up with Pergamon Press, the Pergamon Institute, I. R. Maxwell, and so on, there is a leaflet available from the Institute at Headington Hill Hall, Oxford.

A thing about which I have wondered in connection with American journals is their habit of enclosing detachable prepaid postcards on which one rings a code number and gets information about a specified advertised product in return. I wonder if it is worth it to the advertiser or to the journal? If one is *really* attracted to an item, surely one is energetic (and courteous) enough to drop a line to the advertiser? Most big firms maintain public relations and publicity departments at great expense so they can hardly expect the journals in which they advertise to act as agents as well. Or perhaps they pay more for their ads. that way?

There aren't all that number of references on windmills so somebody might like to know of "Criteria for design of windmills for low to moderate wind velocities" (a sort of puffmill, so to speak). It appears in Section A (general) of the *Journal of Scientific and Industrial Research*, New Delhi.

Butterworths (4-5 Bell Yard, Temple Bar, London, EC2) announce, in advance, *Polymer*—a journal to promote the science of large molecules. A quarterly, it will start in January at £5 a volume. The volume will be about 500 pages.

Applied Mechanics Reviews, the ASME publication, has a review article in the September number on "Trends in the Kinematics of Mechanisms," by Freudenstein of Columbia (University, not Broadcasting System), with 71 references.

My old friends the American Society for Testing Materials—at least that's how I feel since I wrote a notice of what seemed like 2,223 volumes of their standards—have come along with another of their STP series. This is number 237 and is entitled "Symposium on the Basic Mechanisms of Fatigue." The price is $3·75 and I have an idea that the British Standards Institution will get it for you. In case not, the address is 1916 Race Street, Philadelphia 3, Pa. The same crowd have published a 1959 supplement to the "Bibliography of Spectrophotometric Methods of Analysis for Inorganic Ions" (STP 125A) at $1·75. The original bibl. was done in 1952 and this brings it up to (but not, I think including) 1959. As a bit of negative information which I am including because I like the words, this does not cover fluorescimetry, flame photometry, nephelometry, turbidimetry and spectophotometric titrimetry, with my compliments to the printer who has to set that lot up. Oh—I forgot, papers based on Bobtelsky's heterometric titration method are also omitted.

For those of you who collect addresses of purveyors of back numbers of periodicals, I offer Paul Gottschalk, Inc., 21 Pearl Street, New York 4. Sample price: odd volumes of ENGINEERING at $4.50 each. None of the volumes contains "On the Shelf."

HOW MIGRANT SEEDS TAKE ROOT IN BRITISH SOIL

American Investment in British Manufacturing Industry. By JOHN H. DUNNING. *George Allen and Unwin Limited, Ruskin House, Museum Street, London, WC1.* (35*s*)

The first purpose of this book is to describe one little known area of British industrial life namely, the activities of a growing number of firms who are either affiliated to, or owned by, American concerns. In the post war years this invasion by American capital and know-how has come increasingly before the public eye, both as a result of the Government's efforts to diversify industry in the "development areas" (where many of these firms have located themselves) and also because those fields in which these American firms tend to operate—office machinery, heavy earth moving equipment, motor cars and other durable consumers' goods—have been experiencing something of a boom.

Dr. Dunning has performed his basic survey very well. The core of his book is information which has been gathered by questionnaire and personal interviews from more than 200 United States affiliated companies in Britain. This was a necessity, if laborious, procedure because there is so little published information about these companies, but this study goes far beyond the mere collection and classification of data and therein lies its importance. Because these firms are using American techniques of design, production and management in the *British* environment, their experience provides to some extent a "controlled" experiment of a type seldom possible in studies of industrial efficiency. From such firms working both in America and in Britain we can hope to learn how far American efficiency is due to a lucky endowment with natural resources like cheap raw materials and cheap inland water transport. Such study should also show how far high American productivity derives from the existence of a continental market undivided by national boundaries and to favourable legal institutions and other man-made influences on competition and efficiency. Above all we should get some idea of the relative efficiency of British and American management since, in part at least, they are working under comparable conditions.

These fundamental questions Dr. Dunning sets out to illuminate if not to answer. In addition to straightforward factual questions about their size, when they started, the proportion of their capital which is American owned, these 200 firms were asked more qualitative questions about the relative efficiency of their British and American factories; the extent of American influence on policy matters such as the structure of management, research and development, and commercial policy; and American influence upon a host of more technical and vitally important matters like methods of purchasing and systems of wage payment.

As is always the way with empirical investigations of the industrial world no conclusive generalisations emerge from this study but some reasonable inferences can be drawn from the balance of evidence collected. Dr. Dunning's material indicates clearly enough the importance of the general economic environment in promoting high productivity, for something like three-quarters of the replies to his questions showed that man-hour productivity in the American plants was higher than those in Britain, a difference which was also reflected inversely in higher British costs. Even more interesting is the evidence that, given British conditions to work in, American techniques of management applied in their British subsidiaries attain higher efficiency than the native British-owned competitor firms.

The book does something to explain these not altogether unfamiliar facts. The most important difference of industrial environment as between Britain and America seems to be the vast scale of the market on the other side of the water. Several of Dr. Dunning's respondents stress that our smaller market makes certain highly efficient special purpose machines and expensive processes uneconomic to apply. But the Americans clearly have an edge in many other ways as well, and some of these are difficult to explain away. The following catechism of productivity was quoted by one firm which found the difference of 57 per cent in productivity of its British branch and the American parent unit. It found that this difference was made up as follows: 8 per cent more efficient die-casting; 8 per cent more productive plant; 8 per cent more efficient operators; 8 per cent more efficient supervision and organisation; 6 per cent longer experience of production; 5 per cent longer and bigger runs, less range of models; 3 per cent less safety precautions and guarding; 3 per cent better raw materials and lower standards of finish; 3 per cent more efficient tooling and equipment; 3 per cent no tea breaks; and 2 per cent better materials handling and less congestion . . . in the United States.

Amateur critics of British industry please note: those two old chestnuts, tea breaks and the inefficiency of British workmen, account for only a minor part of this difference. Other things are much more important. But the rest of us should recognise, nonetheless, that in this case they did amount to an 11 per cent difference in productivity. The emphasis in this example on long runs and standardisation as a cause of higher productivity is also familiar and supports much evidence gathered by various post-war productivity missions to the USA. However, the real lesson of this example is surely the diverse sources from which high industrial productivity must be wrested. Too often people assume that high productivity comes from really big changes like Henry Ford's revolutionary approach to vehicle manufacture. So it does, but barely once in a generation, so that for the most part improving productivity is an unromantic business of patiently pinching and scraping, a continuous and arduous struggle for ha'pence.

This book also illustrates another important fact about high productivity—to a great extent its effects are cumulative and self-sustaining. As productivity rises, wages rise, markets grow and the scale of production can be enlarged thus raising productivity. As the scale of production rises it pays to invest capital more intensively and to break work down into specialised operations which can use highly efficient machines, themselves only economic if used on large volumes of work. This process applies to human capital too. As output rises jobs can be made more specialised thus permitting a higher level of individual efficiency. Also, highly paid experts can be employed to design, buy and control, all in the interests of efficiency. Supervisors can be more highly trained, and since high productivity usually goes hand in hand with shorter working hours, the general level of education rises in the community reacting once again upon the personal efficiency of work-people as a whole.

This book is aimed primarily at research workers in industrial economics and so its purpose is to give facts rather than to illuminate those more general themes which are of interest to the lay reader. Unfortunately the many people in industry who would be stimulated and interested by this book will not find it easy going, as even the concluding pages which draw the findings together are as overwhelmed by detail, as is the rest of the book. One can only regret that Dr. Dunning did not include one general easy-to-read chapter outlining his main findings and their significance for Britain's industrial future. However, the general reader will find the first chapter, which provides a sketch of the development of US investment in British indus-

try, relatively easy going and most interesting. It is surprising just how many British firms have an American origin of some sort. Others with the cause of industrial efficiency near their heart would do well to consult chapter 5 on "comparative operating methods and productivity," chapters 6 and 7 which discusses the influence of these US firms both on their competitors and on their suppliers and, finally, chapter 9 which deals with the managerial techniques adopted by these American affiliates working in Britain.

DO NOT DISTURB

Vibration and Shock Isolation—A Survey. By J. A. MACINANTE. National Standards Laboratory Technical Paper No. 10. *Commonwealth Scientific and Industrial Research Organisation, University Grounds, City Road, Chippendale, Sydney, New South Wales, Australia.* (*Gratis.*)

The isolation of vibration and shock is especially important for delicate instruments and precision machine tools. Although much work has been done in this field over the years, trial-and-error methods of isolation are still freely used and will continue to be, because a thorough analysis may be rendered impracticable by high cost or inadequate data. Although the trend in industry is towards the use of floating seismic-block mountings for large machine tools, there is still a reluctance to adopt these more costly installations because there has been so little experimental confirmation of their effectiveness.

So writes J. A. Macinante in a second survey of *Vibration and Shock Isolation*, published in pamphlet form by the Commonwealth Scientific and Industrial Research Organisation. The survey has been written for the guidance of people who install and use such precision equipment and who are not primarily engaged in vibration work. The review briefly covers the sources of vibration, its transmission and effects. The essential basic theory of shock isolation is given dealing with single and multi degrees of freedom. A review on the practical types of vibration isolating mountings is given, together with the general design procedure. Vibration-isolating materials are listed. The mountings for instruments subjected to vibration shock are reviewed.

Each aspect of the subject is discussed in the light of the essential information obtained from the appropriate papers in the bibliography which contains two hundred references. This makes the survey more valuable, as the reader gets a brief but well balanced résumé of the papers which may be consulted for further study. The survey succeeds in its object and will prove extremely useful to those concerned with the isolation of vibration and shock.

BEYOND THE CALL OF DUTY

Editorial Notes from "Concrete and Constructional Engineering." By H. L. CHILDE. *Concrete Publications Limited, 14 Dartmouth Street, London, SW1.* (7*s* 6*d*)

Should the editor of a technical journal flatter or flagellate his readers? Should his editorials keep to the safe path of technical discussion or should he tempt engineers into the unaccustomed paths of philosophy and the social sciences? The managing editor of *Concrete and Constructional Engineering*, himself a layman in the subject matter of his journal, has no doubts where his duty lies. He agrees with those who view most of our technologists as illiterate men, hardly able to express themselves and so the easy victims of loose thinking, and believes it his duty to do something about it.

Here are collected together some of the editorials which he has been writing over a period of nearly forty years and which, judging from some quoted comments, have aroused varying passions in the breasts of his readers. As he says in an introduction, the main purpose in writing these articles has been to encourage engineers and scientists to explore beyond technical problems and to improve their general education.

In the course of undertaking this undoubtedly valuable task he may sometimes himself be led into those not fully examined statements of which he is himself so critical. For instance, the figures in support of his view that there has been a "deplorable lowering of the standard of education" would hardly stand up to statistical examination and his opinions on this subject are certainly not universally shared.

Whether or not it is true that engineers are more narrowly specialist than the followers of other vocations, the plea for a broad education, however achieved, is one that needs continual reiteration. To this end a technical journal, through articles only indirectly connected with its specialism, can contribute. History and the social sciences are obvious links between engineering and the humanities; but now that the engineer and the architect are often as nearly one as in the days of the Romans or the Renaissance, aesthetic appreciation is an equally valuable subject. Not surprisingly, several of these articles deal with problems of architectural design. Whether or not concrete engineers have become better men as a result of these monthly prods it is impossible to discover; but some, at least, must have been stimulated to new ways of thought or new fields of study.

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Marine Auxiliaries. TELEGRAPH CONSTRUCTION AND MAINTENANCE CO. LTD., Telcon Works, Greenwich, London, SE10. Winches, capstans, etc., for marine use. Folder.

Iron and Steel Plant. HEAD WRIGHTSON LTD., 20 Buckingham Gate, London, SW1. Four-language booklet outlines the part played by the firm in the erection of the Durgapur steel plant; illustrated in colour.

Research. JOHN THOMPSON LTD., Wolverhampton. The work of the John Thompson Group research centre at Wolverhampton is the subject of an illustrated brochure.

Exploration. HUNTING TECHNICAL SERVICES LTD., 4 Albemarle Street, London, W1. Mineral exploration and survey carried out in Burma. Leaflet.

Montreal. THE CITY OF MONTREAL, Suite 523, Dominion Square Building, Montreal, Quebec Province, Canada. The port of Montreal is described in words, maps and pictures in a 47-page booklet.

Naval Architects. BURNESS, CORLETT AND PARTNERS LTD., Worting House, Worting, Nr. Basingstoke, Hants. History, composition and achievements of the firm are given in a booklet.

Industrial Service. JOHN S. YOUNG & CO. LTD., Burnfield Road, Giffnock, Glasgow. Lines handled include machine tools, storage equipment and handling equipment. Leaflet "Service for Industry."

NEW BOOKS

Temperatur-und Spannungsverteilung in ausgemauerten zylindrischen Reaktionsgefässen. By RICHARD NEUBAUER. *Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany.* (22·50 *DM*)

This monograph on cylindrical reaction vessels appears frightening; the Laplace Transform appears on page 6, and eigen values on page 9. In fact, the last 80 of the 110 pages comprise charts and tables, and the complicated mathematics can be omitted. The problem considered is one of non-stationary temperature distributions in heavy chemical vessels. The book is obviously for the specialist, and the results should be of interest to those working on such problems.

Adhesive Bonding of Reinforced Plastics. H. A. PERRY. *McGraw-Hill Book Company, Incorporated, New York, Toronto, London.* (68*s*)

A useful addition to a literature that is not too wealthy at present. The book was sponsored by Owens-Corning Fiberglass Corporation. A few references are listed after each chapter.

Fédération Internationale de la Précontrainte, Berlin 1958: Papers. Editor: RALPH P. ANDREW. *Cement and Concrete Association, London, SW1.* (11*s*)

This 766 page volume represents the papers of the third congress; the discussions are to follow in a further volume. There are three sessions on, "Developments in Design Methods"; "Progress in prestressing technique as applied on the site, with special reference to grouting, anchorages, reduction of friction and safety precautions," and "Progress in the manufacture of factory-made precast prestressed concrete units and in their use and assembly on the site." The numbers of papers are 24, 19 and 19 respectively. They are printed in their original language but each has a summary in English, French, German and Spanish.

Power Plant Theory and Design. By PHILIP J. POTTER. Second Edition of Steam Power Plants. *The Ronald Press Company, New York.* ($10·50)

Ten years have elapsed since the last edition. It is intended as an American college training textbook to provide the power plant side of a mechanical engineering course. The steam plant is taken as basic but gas, hydroelectric and nuclear equipment are dealt with.

The Physics of Electricity and Magnetism. By WILLIAM TAUSSIG SCOTT. *John Wiley and Sons Incorporated New York;* and *Chapman and Hall Limited, London.* (70*s*)

"The fully descriptive yet mathematical treatment that is provided . . . serves as a smooth transition to more advanced work in physics." An American treatment.

Reading German for Scientists. By HANS EICHNER and HANS HEIN. *Chapman and Hall Limited, London.* (30*s*)

Purports to give a short cut to understanding German texts without "blackboard" learning. One hears much of "spoken" foreign languages being different from the pure but this tackles a different problem. Only a person ignorant of German, using this book and finding it useful, is competent to confirm that the result is satisfactory.

Strength of Materials for Engineers. By D. R. AXELRAD. *Pitman.* (55*s*)

A book for engineering degree students and for those contemplating the Institutions. The author is at Sydney. Worked examples are included as are specimen questions from London University and the Professional Bodies (sic.).

Elements of Materials Science. By LAWRENCE H. VAN VIACK. *Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, USA,* and *London, England.* ($8·50 and 64*s*. International Edition $6·50 or 49*s*.)

An elementary level text for all students of engineering. Metals and non-metals are treated, problems are given, as are lists of references. There is a detailed index.

New Duplex Chromium Resists Corrosion

Thicker coatings of chromium improve corrosion resistance even more effectively than thicker undercoatings of nickel and copper. Work in the USA has resulted in formulation of a duplex coating procedure, in which finely cracked chromium is laid down over a thicker crack-free bright deposit.

For many years, the plating industry has been searching for an economical process for producing chromium deposits with increased resistance to outdoor exposure. Results of recent corrosion tests indicate that thicker chromium, properly applied, is one of the least expensive methods of achieving greater durability. Moreover, work by Metal and Thermit Corporation, of Rahway, New Jersey, USA, and independent studies at Battelle Memorial Institute, sponsored by the American Zinc Institute, have led to the conclusion that " increasing the thickness of copper and nickel is less effective in preventing corrosion than increasing the thickness of chromium."

In America, the automobile industry, the largest user of electroplated parts, has become more and more quality conscious, in response to public demand. As a result, higher performance standards have been set for exterior plated parts. This is borne out by the new severe accelerated corrosion tests developed by the industry in cooperation with the American Electroplaters Society and the American Society for Testing Materials.

NEW TESTS ARE SEVERE

The two new corrosion tests adopted by the automobile industry to evaluate the performance of chromium-plated exterior parts are the Corrodkote and the CASS tests. In the first of these, a standard highly-corrosive slurry is applied as a uniform coating on the part or panel to be tested. After this coating dries, the test piece is placed in a non-condensing humidity cabinet for 16 hours, following which the piece is cleaned and corrosion evaluated. When additional cycles are to be run, the slurry is reapplied at the beginning of each.

An extension of the more familiar acetic acid salt spray test, the CASS test adds copper chloride to the test salt solution, and also increases the test temperature. The rate of attack is thereby speeded up from four to six times.

Sixteen hours of either Corrodkote or CASS testing is generally accepted to be the equivalent of one year's service in the Detroit area—considered to be as severe corrosion-wise as any location in the United States, because of snow and salted streets, and because of its heavy industrialisation.

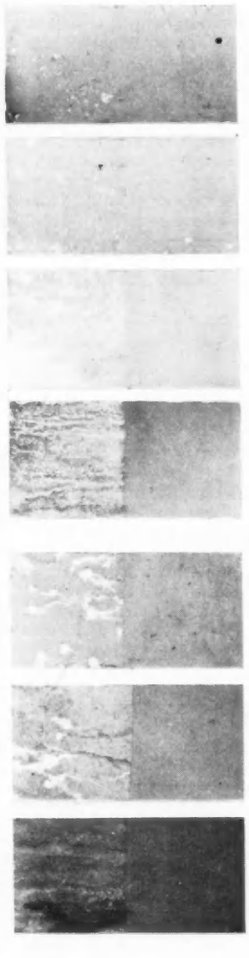
With the standard 0·01 mil (0·00001 in) deposit of chromium that commonly has been specified in the automobile industry for the last 25 years, failures are common in 16 hour Corrodkote or CASS tests. Until recently, it has not been possible to increase the thickness of the chromium without causing high surface stresses; these produce deep cracking and a consequent rapid reduction in corrosion resistance.

In developing a successful duplex chromium process, many combinations of different types of deposits were plated and evaluated. The result was the present duplex chromium process, consisting of an initial application of bright crack-free CF-520 chromium for optimum coverage and build-up in low current density areas, followed by a second bright deposit of finely cracked chromium from a specially-operated CR-110 bath. Neither requires buffing.

It is interesting to note that the latter bath, CR-110, has also been used to produce coatings over ordinary chromium. Success, however, has been limited. The combination is not so effective because ordinary chromium deposits do not provide such good coverage and freedom from cracks as CF-520, in deposits thicker than 0·01 mil.

While a single thick layer of crack-free chromium improves corrosion protection significantly, a second deposit of finely cracked chromium has been found to provide even greater benefits—extending the CASS test performance with 0·1 mil of chromium to approximately 200 hours. Corrodkote tests, normally stopped after one cycle, had to be run six complete 16 hour cycles to reach the same degree of failure.

Effect of increasing coating thicknesses on corrosion of a zinc base alloy.



	Chromium	Cass Test Hours	Corrosion per cent
A	0·01 Mil Ordinary	36	2·5 - 5
B	0·05 Mil Duplex	136	0·5 - 1
C	0·10 Mil Duplex	460	0·5 - 1
D	0·20 Mil Duplex	483	<0·1
	Undercoat = 0·75 Mil Copper, 0·75 Mil Nickel		
E	0·05 Mil Duplex	68	10 - 25
F	0·10 Mil Duplex	136	0·5 - 1
G	0·20 Mil Duplex	483	0·25 - 0·5
	Undercoat = 0·4 Mil Copper, 0·4 Mil Nickel		

DIE CASTINGS AND TRIM

It is more difficult to protect zinc-base die castings than steel, due to the fact that they contain more voids and imperfections. Plating baths cannot bridge all the surface imperfections. However, this new duplex chromium process is producing improvements of 100 per cent or more in corrosion resistance on regular production-run die castings. For example, one large die cast plater who formerly plated with 0·01 mil of chromium on normal undercoats, had only 10 per cent of his parts pass a 16 hour test. Now, with duplex chromium, over 80 per cent of the parts pass a much more rigid 32 hour CASS test.

Metal and Thermit's research personnel in Detroit, and plating engineers in the automotive industry, have conducted many tests on duplex chromium, the results of which may be summarised as follows:

1. While great improvements in corrosion resistance may be obtained by the use of single thick chromium deposits, the most dramatic improvement is obtained by the use of heavy duplex chromium deposits.
2. The use of the duplex chromium deposits has proved successful on steel and zinc base metals.
3. The results obtained are independent of the testing procedure. In other words, quality improvement averages are as great with the CASS test as with the Corrodkote test.
4. The use of increased thickness of chromium has an effect many times that of an equal increase in thickness of the undercoat, when used to protect zinc base alloys. A comparison of panels " B " and " F " in the illustration, shows that an increase of only 0·05 mils of duplex chromium has an effect on corrosion resistance equal to that of 0·7 mils of undercoat. Thickness for thickness, therefore, the duplex plate is fourteen times more effective than the undercoat.

Several producers of electroplated parts for the automobile industry in the USA are already using the duplex process in production, and many others are said to be actively studying it.

POLYCARBONATE IS ALL EMBRACING

A family of plastics known as polycarbonates has been publicised on several occasions during the last year. The one with the name Makrolon is made by Farbenfabriken Bayer AG in Western Germany and is now being distributed in the United Kingdom by R. H. Cole and Company, of Caxton Street, Westminster.

Their name polycarbonate may be reminiscent of baking powders, and in fact this thought is not wholly frivolous, for beneath their complex structure there lies exactly the same, simple carbonic acid grouping as is found in those powders.

The properties of the plastics material are very attractive when compared with others which fall into the same category—the thermoplastics family. Perhaps the one general comment which can be made about Makrolon is that it combines a number of interesting properties which are only found as single characteristics elsewhere. Thus it has a mechanical strength in tension of about 9,000 lb per sq. in which is not substantially lowered even at temperatures above 100° C. It softens at a temerature of 135° C, and good impact strength is retained continuously from this top limit to well below −100° C.

Dimensional stability of this polycarbonate is attributed to two of its other characteristics: first it absorbs only small quantities of water—0·36 per cent being quoted as the maximum pickup—and the rate at which the material creeps under load is very small.

Weather resistance commands attention, for moulded parts stand up to outdoor applications without yellowing, crazing or other deterioration. Ultraviolet radiation, oxygen and ozone are all resisted even above 110° C. Then the material is flame retardant with an ignition point above 500° C.

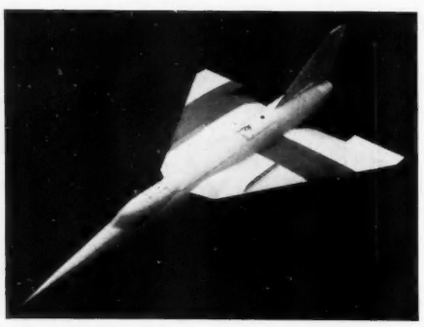
Makrolon is freely available from stock in the form of cylindrical pellets for moulding and extrusion—although there is a separate grade with higher melt viscosity for the latter application. To round off the discussion, it must be added that although basically a transparent plastic, it is easily coloured and can be made opaque. The electrical industry, for one, has welcomed it, for on top of all that has been said its electrical properties are attractive—especially for insulators—and these are constant over its whole working temperature range.

EPOXY MODEL IN FREE FLIGHT

It is not easy to understand how one and a half hours were spent in digging a hole only 2 ft deep, but the fact remains that it did so on the occasion when workers from the Royal Aircraft Establishment recovered a model aircraft which had fallen in free flight from 3,000 ft. The models have built-in instruments and are being used to learn more about spin.

To their credit, those made from glass cloth and Araldite resin were recoverable. Balsa wood smashed irreparably. A reinforced plastic system was chosen not only on account of its strength, but also because it allows high dimensional accuracy to be attained, and it is unaffected by variations in temperature and humidity.

Models in reinforced plastic survive several flights from 3,000 ft.



INFLATABLE METAL TUBING

With American gusto, Calumet and Hecla Inc. of Allen Park, Michigan, USA, have hailed their inflatable metal tube product called Strubing. This comes on a reel and "drastically cuts shipping costs, for only the tube 'walls' are shipped, not the 'holes'." The product appears very similar to that made by the Russians, and the basic idea is that the unreeled tubing should be inflated by hydraulic, pneumatic or mechanical means on site. Calumet and Hecla speak in terms of coil lengths of 15,000 ft and suggest that truck mounted reels could be a quick, economical way of laying temporary pipelines for water, fuel or compressed air. The Russians have already laid six experimental pipelines for gas and oil mains.

A further prediction by Calumet and Hecla is that it will be used for "lining-by-inflation" in which a length of Strubing would be inserted into a vessel or pipe and inflated. This could, of course, have already been done for straight runs with ordinary tubing—but how about bends?

Processes used by the two countries differ: to make a tube with a bore of 6 in, the Russians would start with a hollow cast ingot 8 ft long with an outer diameter of 11½ in. The inner surface would be stopped off with talc and spindle oil and then rolled. The Americans, it appears, would follow conventional tube rolling means, and would flatten the product only when near its final size. For both, there is the problem of removing the outer fins formed at each side of the strip. The Russians trim it off prior to inflation—the Americans "sell" it: "these add stiffness to the thin walls," they say, but add that they could always be removed after inflation.

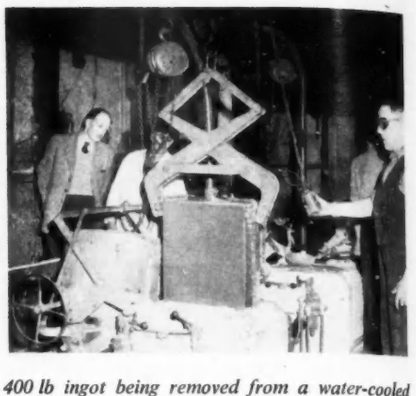
GOLDEN ALUMINIUM JUBILEE

Aluminium Corporation is certainly not the largest aluminium company in the United Kingdom, but it still has a very good reputation—a reputation for quality which has been established over 50 years. "I have heard the quality of Dalgarrog products extolled—or violently cursed, depending on whether you are a user or competitor—in many parts of the world," said the chairman at the Golden Jubilee of the Corporation.

In 1949 British Aluminium Company took over the main holdings and there immediately started a decade of modernisation. The latest development started three years ago when it was decided to replace the old 3-high hot mill. Into the new 2-high reversing mill are fed, surprisingly perhaps, 400 lb ingots which are still cast individually in water-cooled tilting moulds as shown in the illustration. These are "topped up" by hand as they solidify, and neither the Corporation nor BA are sure whether the quality of the final sheet originates in this casting process or whether continuous casting would be an improvement.

The accent on quality arises from the fact that 80 per cent of the Corporation's sheet goes out in the form of blanks used mostly for deep drawing or spinning into holloware. Both of these demand high grade sheet especially with regard to uniform properties and non-directionality. Contributory to this end, it is interesting to note that before cold rolling, sheets are annealed in a molten salt bath which removes the oxide film. Automatic gauge control on the cold mills is "coming"—probably combining measurement of both thickness and roll load to provide the correcting signal.

Two engineering activities appear worthy of mention: in order to produce blanks with an "untorn" edge, the clearance of punch in die is only 0·001 in, and there is a slight inward taper on the die so that sheared surfaces are honed before dropping through. As a last effort to make inspection easier, a machine has been designed to lift discs, turn them over to show the underface, and reject or pile them with paper spacers.



400 lb ingot being removed from a water-cooled tilting mould.

HONEYCOMB RESISTS ROCKET BLAST

Rocket blasts often exceed 6,000° F in temperature. What, then, can be used for such components as deflector plates which undergo direct impingement?—basically nothing is completely unattacked, but materials can be chosen which have a low rate of erosion. Among these, variations on the asbestos-filled phenolic have been often mentioned.

Solar Aircraft Company in the USA have now evolved a material which combines a refractory ceramic, zirconia, with a reinforcing cobalt base superalloy. The structure of the metal is that of a honeycomb with one open face, and if brazed will itself withstand 2,100° F. Zirconia, on the other hand, has a melting point of 4,500° F.

In laboratory tests, the effect of direct impingement of an oxy-acetylene flame at up to 6,000° F is to melt back any alloy which protrudes and then to fuze the zirconia. The structure remains strong because heat conductivity through the sandwich is very low.

In addition to rocket engine applications, the new sandwich structure might, Solar suggest, be used for leading edges of glide vehicle wings, and for nose cones of reentry missiles and satellites.

IMPROVED GUNMETAL

"Standard gunmetals in use today have been evolved by trial and error" say the Mond Nickel Company. "What is more, none is ideal for making quality castings."

Even now, however, the metallurgists's method of making new alloys may still usually be called "logical trial and error"—predicting or finding an alloying trend and then trying it out. Whether Mond would agree with this or not, they have hit on an improved version of an old servant. It is a modified 5Sn-5Zn-5Pb-copper gunmetal which under BS 1400 : 1948, "Copper Alloy Ingot Sand Castings," could have up to 1·0 per cent nickel. In the new alloy, nickel has been increased to 2 per cent, with an increase in tin, while zinc and lead are lower—the new composition, 6·5Sn-3Zn-3·5Pb-2Ni-copper.

Mechanical properties are better and more stable than the old at both atmospheric and elevated temperatures, while the alloy still retains the same adaptability to production of pressure tight castings. When properly made, castings in this alloy have a 0·1 per cent proof stress of around 8 tons per sq. in with an ultimate stress of 16 to 17 tons per sq. in in sections up to 3 in thick. The new alloy, Mond say, will enable castings to be more effectively designed, as regards the use of thinner sections, and this could result in saving of weight and cost.

Hydrostatic Tractor Drive Easy to Handle

A conventional gearbox has many disadvantages as a tractor drive. Hydrostatic transmissions, however, give an infinitely variable speed drive and easy handling. The Lucas system is described below.

With a conventional gearbox, a tractor transmission really needs at least six gears (a three-speed box working in conjunction with a two-speed box), and this involves two gear levers and a clutch. Time is thus wasted in gear changing, or the operator just runs the tractor in the wrong gear and so the operation is uneconomical. An alternative is to use an hydrostatic drive which does away with clutch, gearbox and differential. This has two main advantages: it gives an infinitely variable speed drive together with ease of manipulation and handling. The following system is that devised by Joseph Lucas (Industries) Limited, Birmingham.

The Lucas hydrostatic transmission consists in its bare essentials (Fig. 1) of a positive displacement pump (B) driven by the tractor engine (A) and connected by high pressure steel tubing (C) to the hydraulic motors (D) mounted on the wheels, and therefore rotating at wheel speed. The motors can be connected in parallel to the pump by means of the valve (E).

The pump is a continuously variable delivery, seven-piston, axial type (Fig. 3), a basic design that has proved itself over the years in the aircraft industry. The swash plate is movable over 20° in each direction, stroke control being by an integral servo piston. A typical unit delivers 6,000 gallons per hour at 2,000 r.p.m. at 3,000 lb per sq. in.

The hydraulic motor is shown on the wheel in Fig. 4. There are two Staffa units (one on each wheel) on this equipment, made by Chamberlain Industries Limited, Leyton, London, E10. Each is a slow speed (100 r.p.m.), high torque (4,600 lb-ft), five-piston radial power unit, with a maximum pressure of 2,000 lb per sq. in. The motor is fully reversible.

The overall efficiency of the motor-pump combination is such that the motor efficiency is about 90 per cent and the pump efficiency 85 per cent.

Control is from the driver's seat, by means of the engine throttle (not shown) and the pump stroke control, see Fig. 2 and item (F) in Fig. 1, on the left-hand side of the tractor. When the lever is in the central slot, the pump is in neutral and there is no power supply. By pushing the lever forward the tractor travels forward at a speed depending on how far the lever is moved (and on the throttle setting). Pulling the lever back puts the tractor in reverse, the speed once again being governed by the drive, which is thus infinitely variable. Speed reduction is available by pulling back the lever, demonstrating the inherent braking possibilities of the system.

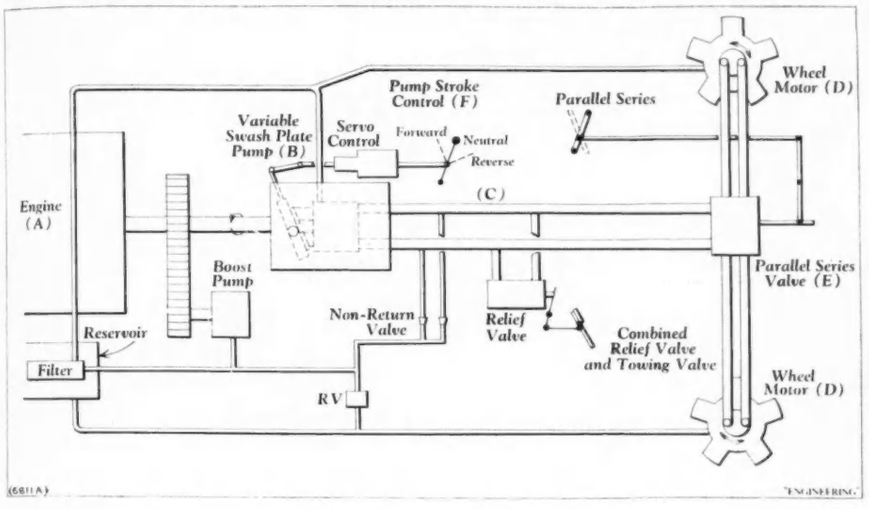


Fig. 1 (above) Diagrammatic layout of system.

Fig. 2 (right) Pump stroke control in action.

Fig. 3 (left) Internals of the variable stroke pump.

Fig. 4 (right) Hydraulic motor fitted to wheel.

GAS-TURBINE WATER PUMP FOR FIRE FIGHTERS

The 50 h.p. Mars gas-turbine water pump, which is made by Perkins Gas Turbines Limited of Peterborough, weighs only 172 lb, can be carried by two men, and delivers 500 gallons of water a minute at 100 lb per sq. in (this is shown at P in Fig. 1).

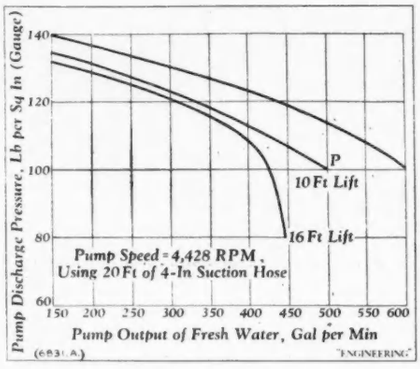


Fig. 1 Discharge characteristics of the Mars gas-turbine water pump.

The Mars is one of the smallest gas-turbines in production. Including gearbox and all accessories it is only 22 in high, 17 in wide and 24 in long and weighs 98 lb. This represents a power-weight ratio of about 1 : 2 compared with that of 1 : 10 for modern compression ignition engines of the same rating.

Intended primarily for emergency and standby applications, the gas-turbine has been designed for instant starting by hand or electric motor, reliability, easy handling, fuel versatility, minimum maintenance and long life.

It has many uses, including the pumping of liquids and fuels, ships' salvage operations, shipboard de-icing, smoke screen generation, air compressors, the generation of electricity.

The turbine assembly employs a single-stage centrifugal compressor, single elbow combustor and a single-stage radial inward flow turbine. Air enters the compressor through a screened annular inlet case leading to a centrifugal impeller. From there, the air passes through a radial diffuser and is collected by a compressor scroll. This directs the compressed air into a combustor where fuel is injected and burnt to produce combustion gases at high temperature. Ignition (required only for original light-off) is by means of a sparking plug. The gases then flow to the turbine, where they pass through a scroll to a nozzle ring which directs them radially inward against the vanes of a turbine rotor. After expansion, they exhaust axially through a short tailpipe. Fig. 2 shows the engine as seen from the compressor end. The turbine rotor and compressor impeller are mounted back-to-back on the same shaft and are separated by a seal plate, as shown in Fig. 3.

The turbine rotating assembly has a speed of about 40,000 r.p.m. at the rated output. The standard gearbox reduces this speed to about 4,400 r.p.m. by means of a spiral bevel wheel and pinion of 9·1 to 1 ratio. The gearbox output shaft, lying at right-angles to the turbine shaft, runs on anti-friction bearings. Accessory gears driven from this shaft drive a constant speed governor, over-speed safety shut-off, fuel pump and lubricating oil pump.

The turbine runs equally well on diesel fuel, paraffin or low-grade petrol.

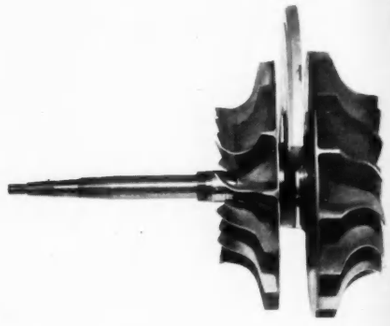


Fig. 3 Compressor and turbine rotor assembly of the gas-turbine, with half the seal plate in position.

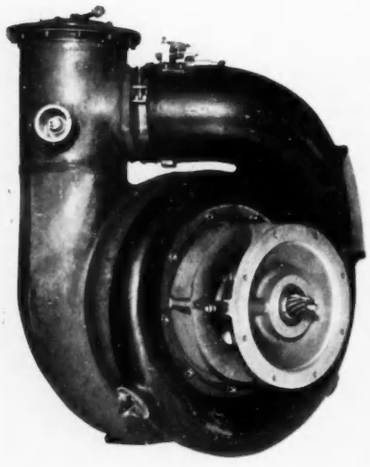


Fig. 2 (left) The engine as seen from the compressor end.

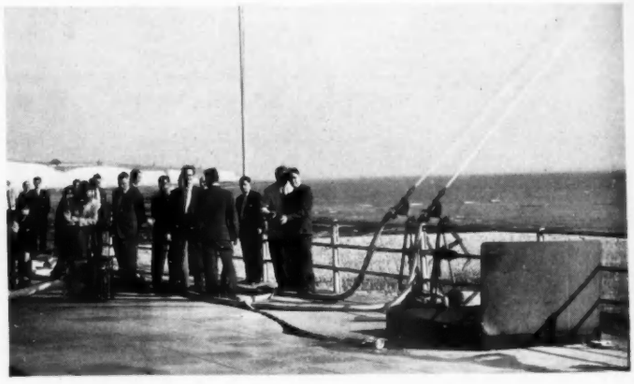


Fig. 4 (right) The gas-turbine in action as a water pump.

HOW TO PREVENT UNDERCOOLING IN CONDENSERS

An investigation has been carried out by John Brown and Company (Clydebank) Limited with the object of preventing undercooling in condensers on board ship. By agreement with the BP Tanker Company Limited, the system was tried out during the trials of the British Judge in April, 1959. The system is being repeated on their latest tanker, the British Queen.

In the initial stages of consideration of a.c. motor-driven auxiliaries, one of the main objections put forward was the lack of control of fans and circulating pumps, as compared with a.c. drive. Initially this difficulty was met by introducing two-speed motors, but at considerable cost, and recently it has been shown that this could not be justified, except for a vessel having a very wide range of power.

The current practice in the case of tankers operating under steady steaming conditions is to have a single-speed motor for these particular units. Due, however, to the considerable variation in sea water temperature, which is experienced in tanker service, the lack of control for circulating water conditions in the condenser may give rise to a considerable degree of undercooling, with a consequent loss in performance, and in some instances it is not appreciated by engineers that a high vacuum in itself may mean a loss of efficiency.

To operate at maximum efficiency, it is essential to run a turbine plant as close as possible to the design conditions: in particular, the design vacuum should be maintained. Apart from this aspect of undercooling, higher vacua may affect the life of the turbine because the steam leaving conditions are not according to design and possibly because the higher moisture content causes erosion of the blades and casings.

While a degree of control can be obtained by closing the circulating water overboard discharge valves, when the sea water drops below design temperature, this in itself is not sufficient, for it means that the circulating pump is then working away from its design condition of efficiency and the reduction in the quantity of water passing through the condenser may cause a loss of vacuum.

With these difficulties in mind John Brown for some time explored the possibility of recirculating the condenser sea water discharge, and although initially the pump manufacturers expressed some doubt as to the effect on the pump, on further consideration they were quite happy about the idea. From each main circulating discharge pipe in the condenser a recirculating pipe is taken to the suction side of each pump. A feature of the arrangement is the recirculating valve, in the form of a retractable scoop, which effectively diverts the water to the recirculating pipe and at the same time maintains resistance in the discharge system.

The design condition for the condenser was a vacuum of 28·5 in Hg at a sea water temperature of 75° F. During trials conducted on the Clyde, the sea water temperature was about 49° F. By means of the recirculating connection, the inlet temperature of the water to the condenser was increased from 49·5° F to 67° F with a vacuum of 28·48 in. Under this condition the amount of undercooling was 0·5° F. With no recirculation, the undercooling was 3° F. The combined effect of undercooling and depression of condensate temperature resulting from increase of vacuum amounting to 20·5° F could represent an increase in fuel consumption of 1 per cent.

(*Above*) *For the sport of karting, this foot-controlled Trokart.*

(*Right*) *This Surrey can be built with an L. F. Ward kit.*

(*Left*) *The Austin Seven has a front wheel drive.*

(*Right*) *The Daimler 2 litre V8 sports car.*

The David Brown 3·7 litre Aston Martin DB4 GT model develops 302 b.h.p. at 6,000 r.p.m. It has three Weber carburettors and Girling disc brakes.

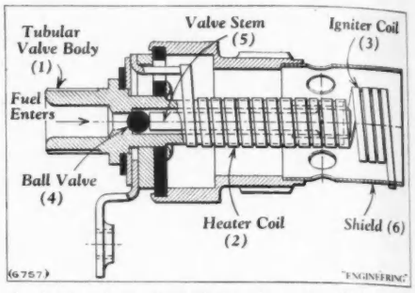
This Armstrong Siddeley Star Sapphire 6 light saloon has a Borg-Warner automatic transmission and Burman power steering as standard equipment.

The Mark III Sunbeam Rapier has a 1½ litre engine with an aluminium cylinder head for high efficiency and a compression ratio of 9·2 to 1.

The Russian Volga M-21K sold by V/O Avtoexport, won the Grand Prix at the Brussels Exhibition in 1958 and is on show here for the first time.

DIESEL ENGINE STARTING MADE EASY

Designed to assist the starting of diesel engines at low temperatures, the Thermostart Mk. III starting aid (CAV Limited, Acton, London, W3) is a development of a previous solenoid-operated model. Although the principle of heating the inlet air, by burning fuel in the induction manifold, is the same, the method of actuation is quite different. The Mark III has a tubular valve body (1) carried in a holder which screws into the inlet manifold, and is surrounded by a heater coil (2), an extension of which forms an igniter coil (3). The valve body carries a central valve stem (5), the end of which holds a ball valve (4) in position against its seating. The whole is surrounded by an open perforated shield (6). The fuel is admitted to the heater through the ball valve, normally held on its seat by the valve stem (5). On switching on, current passes through the coil and heats the tube, which expands. The rod is thus moved enough to allow the ball valve to lift and admit fuel; this flows along the heated tube and is vaporised. As the vapour reaches the open coils of the element (which reach ignition temperature) it is mixed with air drawn into the manifold when the starter motor is engaged, and ignites. When the switch is released, the tube cools rapidly by the flow of air and the central valve stem (5) returns the ball to its seat, and thereby cuts off the fuel.



The Thermostart is inserted horizontally in the induction manifold through a tapped hole.

PARTS FEEDER SOLVES HANDLING PROBLEMS

An unusual application of a newly designed parts feeder, made by the Sinex Engineering Company Limited, Feltham, Middlesex, shows how precise these machines can be. It is just one example of the many parts-handling problems solved by designers for a particular client.

The bowl feeder shown feeds and times the diamonds of gramophone stylii automatically to a rotating glass disc provided with a groove for the diamonds. This presents them beneath the objective of a projector, so that a magnified image of the diamonds is projected on to a calibrated screen.

There are two control knobs placed conveniently for the inspector. One stops the rotation of the disc when closer examination is required; the other (a reject button) is connected to a compressed air supply from a miniature compressor fitted in the control box, seen on the left of the photograph. The inspector, by pressing this knob, can release a jet of air through a hypodermic needle situated opposite the diamond under inspection, so that it is ejected if it does not conform to profile.

The little parts feeder itself (shown in the foreground) performs two important functions, in addition to that of feeding diamonds:

(1) For convenient inspection, the diamonds must be fed on to the rotating disc at suitable intervals determined by the distance which spaces them apart. This is achieved by a microswitch (fitted to the side of the bowl near the outlet) which operates a knife, the top of which lies in a slot flush with the outlet flight. The knife acts as a gate and by means of an electronic timer (also contained in the control box) allows one diamond to pass at a time at intervals controlled by the timer.

(2) The automatic rejection of overlengths is done by timing each diamond as it passes over the slot in which the knife rests. The acceptable length is translated into milliseconds on a second timer, also fitted in the control box. Overlengths are automatically rejected into the bowl, by the operation of the knife coming up through the slot.

MULTIPLE CAR TRAINS FOR SUBURBAN SERVICE

The first of the new diesel multiple unit trains on the St. Pancras-Bedford line were recently put in service. The cars, designed to meet the needs of suburban traffic, have been built as four-car units that can be run as eight or twelve-car sets, by coupling two or three sets together.

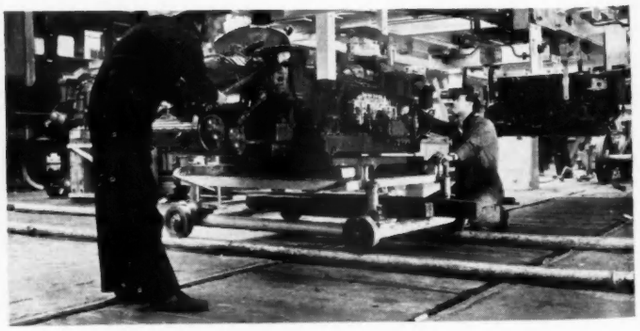
The motor-cars are each powered by two 238 b.h.p. Rolls-Royce 8-cylinder diesel engines located under the floor and driving through Twin Disc torque converters up to a speed of about 46 m.p.h. The drive then automatically changes to direct coupling, the torque convertor being disengaged. The final drive unit on the axle also includes the reversing gear. The total h.p. for the four car set is 952 and the power : weight ratio 7 to 1. The estimated weight of the motor-car is 40 tons.

The body and roof framing are of conventional British Railways design in top-hat section $\frac{1}{8}$ in thick, the bodyside and roof panelling being 16 s.w.g. sheet steel. The driving compartment canopies are of moulded polyester glass laminate. The underframe is of mild steel welded construction, 63 ft 5 in long over headstocks, 46 ft 6 in bogie centres. The solebars are 7 in × 3½ in channel section, and the main longitudinals are 10¼ in deep, of welded angle and plate construction. The side buffers are of the self-contained type with rubber springs, and the drawgear of the central screw coupling type with rubber springs situated behind the underframe bolster.

A quick release vacuum brake is provided, an exhauster being mechanically driven from each engine. The system consists of a normal 21 in (Hg) of vacuum in the train pipe and 27 in (Hg) vacuum in the exhauster pipe and reservoirs. A feed valve is interposed between the driver's control and the exhausters so that the brake release can be entirely independent of the exhauster speed. A Lap position incorporated in the driver's control isolates the train pipe from the exhauster pipe, to give any desired degree of braking.

An interesting feature is that the lighting supply is from a 24 V battery system, the supply being stepped up to 240 V, 1,000 cycles a.c. by means of transistor oscillators, one oscillator being arranged to supply each 40 watt fluorescent lamp. The fluorescent lamps are arranged in a single line down the centre-ceiling of each vehicle. The current for both lighting and controls is supplied from a 440 amp hour lead-acid battery carried on the underframe.

(Left) Inside the power car while it was being built, looking forward.



(Below) Fitting the 238 b.h.p. diesel engine to the underframe.

Production

CUTTING OUT WASTE IN CUTTING UP STRIP

The end product of a steel rolling mill is a length of steel section, which can be up to 200 ft long. Except in the unlikely event of someone being able to use such a length, the steel has to be cut at the hot saw bench to suit the requirements of the customers. This operation has led to a waste in the past because there are inevitably the odd few feet left at the end which have to be reprocessed. It is rather like the old problem from school about filling milk churns. An idea has been put forward at the British Iron and Steel Research Association for a method of saving this waste which is both simple to operate and cheap to install. Laboratory tests have suggested that it is possible to reduce waste to an average of about 0·2 per cent, the allocation of lengths taking about 20 seconds.

Briefly, the method uses to-scale lengths of wood or plastic rod to represent the customers' orders. A selection of the rods is used to fill a groove which represents in its turn the length of the complete rolled section to the same scale. The operator can thus see how well he has employed his section before he carries out the irredeemable step of cutting it up. When he is satisfied that he has made best use of the section available he reads the dimensions from the rods and sets about the section with the saw.

Some thought has been devoted to the organisation of such a scheme, and it is suggested, by BISRA, that it should be worked as follows:

The department dealing with incoming orders would keep a stock of the rods, and as each order was received would choose existing rods of the correct length or would cut off rods accurately to the required length. They would then mark on each rod its length and order number. All the rods representing the work to be done by one shift would then be sent to the saw bench and stored in rows according to length. After the completion of an order, the rod which represents it would be sent by conveyor to the cooling beds or despatch department. Thus there would be batches of rods being fed at intervals to the selection table at the saw bench and a stream of them representing the orders going to the despatch department.

Laboratory trials have been carried out with a prototype apparatus to determine how quickly the operation can be carried out and with how much less waste on the saw bench. During the trials an improved version was designed which is available for demonstration and works trials.

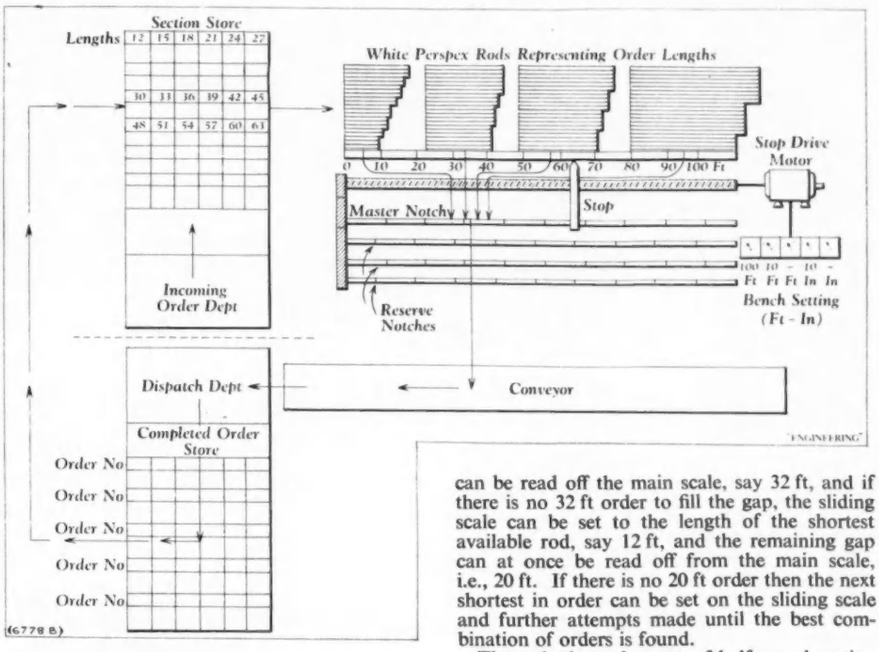
The V groove representing the length to be cut is a right angled-section fixed to the bench with its sides at 45° to the horizontal. One end is blocked off and an adjustable stop slides up and down the groove. The total length of the groove from the blocked end represents 250 ft. This is used to set the adjustable stop to represent the uncut length of section.

There is also a sliding scale marked from 0 to 50 ft which is used to help in the filling of the last 50 ft of the groove. Thus, when the groove is almost filled, the length remaining to be filled can be read off the main scale, say 32 ft, and if there is no 32 ft order to fill the gap, the sliding scale can be set to the length of the shortest available rod, say 12 ft, and the remaining gap can at once be read off from the main scale, i.e., 20 ft. If there is no 20 ft order then the next shortest in order can be set on the sliding scale and further attempts made until the best combination of orders is found.

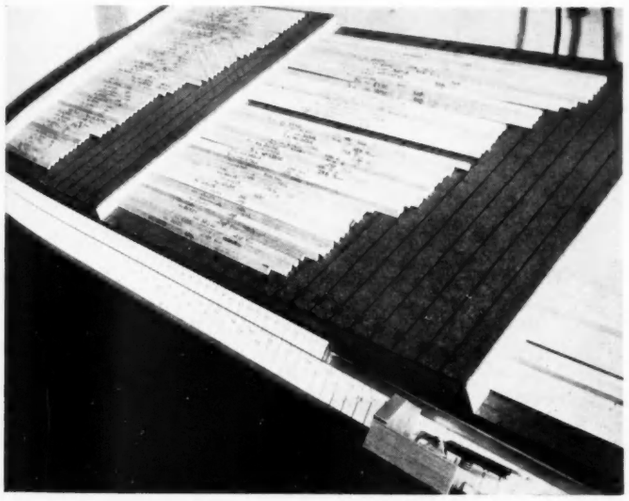
The rods themselves are of half-round section and are marked on the flat sides. They are laid singly, parallel to the groove, with their marked faces uppermost, in four racks. Each rack being slightly inclined to the horizontal so that the rods will butt against the end of their rack. Vertical lines representing 2 ft intervals are marked on the racks so that the approximate lengths of the rods can be quickly estimated.

In a series of laboratory trials carried out on consecutive days by one subject, the average time per operation was less than 20 seconds with an average waste of 0·2 per cent. In all cases the adjustable stop was set by hand; an operation which took from two to four seconds. The results of these trials are claimed to support the conclusion that the Sectionmaster, as the apparatus is called, could be operated speedily enough to maintain the pace required on the saw bench and could bring about a worthwhile reduction in waste.

It may be possible to improve the performance of the Sectionmaster in several ways. For example, it would be possible to have more than one groove, so that several grooves could be partially filled before the operator knew the rolled length. He would then only have to complete the filling of the groove after setting the stop. Another possibility is that the length of the section could be measured automatically on the run-out table and the stop set automatically in the groove by a servo-motor. Colour codes could be used on the rods to ensure that no order would be neglected for too long.



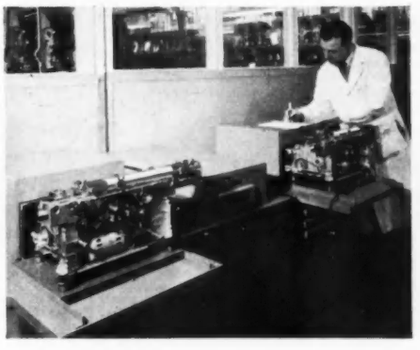
(*Above*) *Schematic diagram showing the layout of the Sectionmaster and the suggested flow of the rods.*



(*Left*) *A close-up view of the Sectionmaster showing the rods which represent orders and the groove into which they are fitted, with its adjustable stop and sliding scale.*

TESTING TYPEWRITERS

At what is reported to be the largest typewriter manufacturing centre in the country, Remington Rand Limited test their products on the illustrated "auto tester." One completed typewriter in every production batch is given a punishing test by this "robot typer." Powered by compressed air and controlled by a prepunched paper roll, the machine simulates the action of a high speed typist, and subjects the typewriter to the equivalent of two to three years hard use in a commercial office. After the test the typewriter is dismantled and the parts are closely examined.



Hard Facing Reduces Maintenance Costs

Very large sums of money are spent annually on replacement of worn machine parts. Considerable savings are possible by hard facing the wearing parts with special alloys, deposited by welding.

By N. D. Berrick

Managing Director, Cobalide (Industrial) Pty Limited, Australia

Hardfacing—the deposition by welding of a layer or layers of special hard alloy—is not new, but developments in manual electrode manufacture have increased its scope greatly. Hard alloys can be deposited on cast iron, plain carbon and manganese or other alloy steels using standard a.c. or d.c. arc welding equipment. Relatively low cost, spatter-free, tubular electrodes, as large as $\frac{7}{16}$ in diameter, give increased metal deposition and recovery rates and reduce the welding operator's time to such an extent that reclaiming of even large parts is now a practical and economic proposition.

By connecting two of these large electrodes together with wire clips or adhesive tape, it is possible to increase the deposition rate by 80 or 90 per cent. This is done either by using a Twin-arc welding machine or by coupling two separate transformers so that the phasing of both primary and secondary is in parallel. A standard Twin-arc electrode holder, with slight modifications to the jaws to hold the two $\frac{7}{16}$ in diameter electrodes is all that is necessary. Any insulating material, such as asbestos or fibre board, is adequate to separate the stub ends.

Tubular electrodes have the alloying constituents inside. Being thin walled they can include high alloy and carbon contents, giving high carbide deposits. In this respect they are superior to the orthodox core wire type electrodes, which rely mainly on pick-up of alloy and carbon from the flux coating. Such electrodes are crimped $1\frac{1}{4}$ in from the end, so that the stub or "throw-away" portion is an empty piece of tube less than half the weight of the core wire type. Hard facing electrodes can also be obtained in cast rod form, but they are generally more expensive than the tubular type. New flux coatings have been developed for both types which are water resistant, so that electrodes can literally be stored in the rain and electrode deterioration losses are nil. Since much hard facing is done in the field, this can represent a distinct saving.

The advantages of hard facing in plant maintenance and production are many. It gives longer life to wearing parts (2 to 10 times or even more, depending on the type of service), increased operating efficiency because original shapes are retained for longer periods (this can also result in lower power costs), reduces idle time of plant, reduces labour costs because replacements are fewer, and reduces the number and value of stock replacement parts. In addition, hard facing can be built up on cheaper plain carbon steel bases instead of using the more costly alloy steel for the whole component and, of course, the hard alloy need only be applied in the actual wearing areas.

Classification of alloys in terms of macro-hardness only can be very misleading, because it does not take into account the microstructure of the material. A more generally accepted method is that shown in the appended table; experience has indicated that it is only the exceptional case which does not conform to this grading.

GRADING

Group 1 alloys based on tungsten carbide have been in use for some time. They have constituents which exceed the hardness of all common rocks and minerals, and although costly they are an economic proposition for use on such wearing parts as are shown in the table.

Hard facing materials based on chromium carbide (group 2) are the most widely used where resistance to extreme abrasion and high impact are essential. An alloy deposit can be obtained which combines the extreme hardness of chromium carbide with the toughness of a complex iron chromium austenite. "Cobalarc 1A" is a typical electrode in this group. It can be applied direct to a wide range of steels, from plain carbon to austenitic manganese and other alloy types, as well as to cast iron. Group 3 alloys have not come into wide use as hard facing electrodes, as they overlap with the chromium carbide austenitic types, but they are now being used as cast materials of construction in some instances.

The cobalt, chromium, tungsten alloys (group 4), which have been in use for many years, have now been largely superseded by the chromium iron alloys of group 2. Experience has shown that in about 90 per cent of ordinary industrial applications where abrasive wear has to be overcome, the chromium carbides give similar service life, and they have the advantage of being cheaper. Group 4 alloys, however, retain their hardness to a relatively high degree at elevated temperatures and have good resistance to certain acids and alkalies; they continue, therefore, to be used where such properties are required. The group 5 nickel base alloys have properties similar to those in the previous group and, although not widely used, are important for specialised applications, as shown in the table.

Martensitic steels (group 6) cover a wide range. Some have been used in considerable quantities because of their ability to give reason-

(Left) Using two $\frac{7}{16}$ in diameter electrodes together increases the deposition rate of hard alloys by 80 to 90 per cent.

(Below) Two bucket teeth subjected to the same working conditions. The lower one was unfaced while the upper was hard faced on two occasions with a chromium carbide alloy.

Grading of Wear Resistance of Hard Facing Alloys. (*In any one group the properties vary, depending on the carbon content and structure.*)

Increasing abrasion resistance				Increasing impact resistance			
Group 1 Tungsten carbide composites	Group 2 Chromium carbide austenitic irons	Group 3 Martensitic irons	Group 4 Cobalt base alloys	Group 5 Nickel base alloys	Group 6 Martensitic steels	Group 7 Pearlitic steels	Group 8 Austenitic steels (Manganese and stainless
Utmost abrasion resistance. Medium impact resistance	Excellent abrasion resistance. High impact, erosion and oxidation resistance	Excellent abrasion resistance. High compressive strength. Low impact	Excellent hot hardness, corrosion and oxidation resistance	High impact, corrosion and oxidation resistance	Medium abrasion and impact resistance. High compressive strength	High impact resistance. Fair abrasion resistance	Excellent impact resistance. Medium to low abrasion resistance. Work hardens under some conditions
Tubular electrodes	Tubular electrodes	Tubular electrodes	Cast rod electrodes	Cast rod electrodes	Steel wire core electrodes	Steel wire core electrodes	Tubular or steel wire core electrodes
Typical recommended applications							
Sand mixer blades; oil-well and rock drills; dry cement pump screws; ripper tynes; pug-mill knives; coal-cutter bits and picks; beaters; post-hole auger teeth; churn drills; fan blades.	Dredge buckets and lips; crusher jaws, mantles and rolls; bulldozer cutting edges and end bits; muller tyres and pathways; sizing screens; pulveriser hammers; agricultural implements; pump casings and impellers.	Similar to Group 2—(chromium carbide type) but not in instances where high impact resistance is required.	Tap-hole augers; coke pusher shoes; expeller worms: pump sleeves and shafts; rolling mill guides; tools; dies, etc.	Valve bodies stems and seats; pump parts, flanges and couplings; acid-resistant scrapers, etc.	Guillotine blades; punches; shears; dies; cams; tappets; lathe tools; wood cutting tools; gauges; reamers; clutch parts; agricultural implements; wheel treads and tyres, etc.	Tractor idler wheels, rollers, track links, and sprockets; bulldozer arm trunions; carbon steel rails; axles; bearing surfaces; chisels; reclaiming of steel parts (other than austenitic steels) prior to hard facing.	Dredge driving tumblers; austenitic manganese steel rail points and crossings; digger teeth subject to extreme shock; reclaiming of worn austenitic manganese steel parts, e.g. crusher jaws, etc., prior to hard facing.

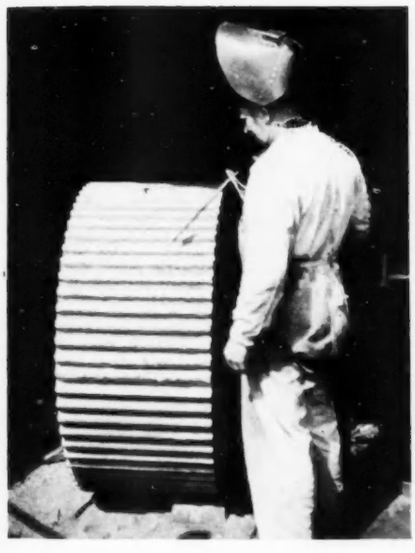
Operation and Maintenance

ably good service under conditions of moderate abrasion, but with increasing loads and higher operating speeds of new equipment the trend is more and more towards the use of group 2 alloys in place of group 6. Pearlitic steels (group 7) might be more correctly called "build-up" rather than hard facing materials. They are of value for depositing steel of up to a hardness of 320 VPN (Rockwell "C" 35) in the as-deposited state. When excessive wear has taken place group 7 electrodes are often used for reclaiming, followed by a hard facing deposit of $\frac{5}{32}$ in to $\frac{3}{16}$ in thick of an alloy from another group having a higher wear resistance. The austenitic steels (group 8), which have high elongations and considerable toughness, are also in use as buffer or under-layer materials; the manganese types are eminently suitable for use on components of 11 to 14 per cent austenitic manganese steel, while the stainless types are used for junction welding and repair of manganese steel parts. Final runs of group 1 or 2 alloys may also be applied.

SELECTION AND APPLICATION

Obviously no single alloy is ideal for all applications. Almost any hard facing material will give at least a slight increase in normal service life, but unless the grade is selected carefully the maximum economy will not be achieved. It is just as unwise to select an electrode on the basis of its hardness alone as it is to pay undue attention to its price. Generally, the cost of the electrode represents only a small part of the total expenditure on the job, which includes dismantling, down-time, operator and power costs and reassembly. Consideration must also be given to the time taken to carry out the hard facing, having regard to the deposition rates of the various electrodes available and, of course, the resultant service life overshadows all the other considerations; it is better to hard face a part once rather than two or three times.

Crusher roll being hard faced with $\frac{7}{16}$ in diameter manual electrodes.



A few examples, chosen from the many on record, will serve to show the sort of service which can be achieved by hard facing. A cement company applied a $\frac{1}{8}$ in deposit of chromium carbide hard facing alloy to a number of ball mill liner plates, which were of chromium steel, approximately 15 in square and 2 in to $3\frac{1}{2}$ in thick. Normally, the useful service life of the plates was 8 to 9 months, but those which had been hard faced remained in use for five years. Even then, some which had only been polished on the surface were suitable for further service in the secondary chamber of the mill. The cost of the plates was £8 each and the hard facing (including labour and material), £4 10*s*. As there are between 900 and 1,000 of the plates in use at the particular plant, it is obvious that the 7 to 1 increase in service life effects a large saving. Additional economies are now obtained by casting the liner plates of 0·3 to 0·4 per cent carbon steel instead of alloy steel.

Quarry and excavating plant provide many examples of economy. A 4 cu. yd dragline bucket, for example, hard faced on the wearing parts with chromium carbide, showed negligible wear after handling about 530,000 tons of very hard gravel.

Hard facing procedure must be based on local conditions. In the case of excavator bucket teeth, for example, the shape, size and composition of the tooth must be taken into account, and the rate and extent of the wear must be considered, as well as the wear pattern. Filler steel sections can often be welded to the worn part, and then covered with hard facing to restore the original shape. It is usual, in the case of teeth, to apply hard facing to one side only—whichever tends to wear faster; this results in the hard facing "standing proud" and gives a self-sharpening action.

Hard facing a muller pan tyre. A jig enables the tyre to be turned easily so that the skip welding technique can be used and excessive heat input into any particular area avoided.

In the case of crusher jaws, distortion and the effect of welding heat on the structure of the base steel must be considered. Manganese steel tends to become very hard and brittle if subjected to high temperatures, and for this reason the material must be kept as cool as possible during the hard facing operation. An effective way to do this is to face a number of jaws at the same time, working from one jaw to another using the step welding technique and at no time depositing a run longer than 4 to 6 in on any one casting. To avoid distortion, jigging is necessary.

The author's thanks are due to Quasi-Arc Limited, Bilston, Staffordshire, for services and facilities made available.

Marketing

Elana in Poland

Polyester fibre developed by Imperial Chemical Industries is to be made under licence in Poland. An agreement was concluded recently between ICI and the Polish foreign trade enterprises Polimex and Textilimport whereby polyester fibre will first be supplied from Britain to cover Polish requirements during the years 1960-64 and will then be produced locally.

The agreement covers the purchase by Polimex of production know-how and a licence to enable a plant to be built in Poland. It is foreseen that the production of the fibre, under the name of "Elana" will start in 1963.

Such arrangements with Iron Curtain countries are likely to multiply during the next few years. The Communist world has made relatively very little headway in the development—or production—of consumer goods or of the materials and machines and equipment needed to manufacture them. Soviet Russia has recently invested heavily in man-made fibre plants: similar action concerning the equipment to produce consumer durables, to process food, manufacture cosmetics and other items which now form part and parcel of high living standards in the West can be expected in due course. The Western countries have a part to play in this similar to that which they played in the early days of Soviet industrialisation.

Economics of Price Cuts

The recent price cuts announced by five of the major groups of companies producing electric lamps were both substantial and widespread. They ranged from 9 to 26 per cent, and were aimed at increasing the volume of these manufacturers' sales. They were made possible, according to the companies who made the cuts, by the introduction of improved manufacturing methods and automatic equipment.

The main reason was in all probability the failure of demand to rise in step with that of other electrical products. Competition from the low price electric lamps sold by F. W. Woolworth doubtless provided a further incentive. Even with the latest price cuts Woolworth bulbs still retail at about 3*d* to 4*d* less than those of other leading makes. The home market is thought to be capable of considerable expansion. At present some 100 million bulbs are sold each year to just over 13 million homes wired for electricity, an average of just over seven per house. But these figures include quantities for new homes and replacement demand is substantially less. Manufacturers aim to increase replacement sales, and to raise the proportion of high voltage lamps in the total. Lower prices will certainly help to convince householders that bulbs are worth changing when they lose their brightness and before they fail (after about 1,000 hours).

Marketing in Europe

The most remarkable feature of the present complex situation of West European trade is the growing disregard of trading companies for the restrictions imposed by the politicians. More and more British companies are preparing themselves for an all-out effort in both Common Market and Outer Seven countries. The latest example of this attitude is provided by Goodyear Pumps Limited, a member of the Holman group.

Since its introduction 18 months ago the Goodyear pump has been adopted by industries in several countries, notably Britain and the US. This "snoring" pump, which has outstanding suction lift and self priming properties, is to be marketed in several European countries. Goodyear Pumps have approached agencies in Denmark, Finland, Italy, Norway, Sweden and Switzerland. Representatives from these firms assembled last month in Britain—at the London headquarters of the company and at the Holman

group headquarters in Camborne, to attend a technical and sales conference.

More East-West Trade

Recent announcements of big deals between East and West suggest that the trend towards increased trade which began when Mr. Macmillan visited the Soviet Union is gathering momentum. Platt Brothers (Sales) Limited, the Stone-Platt Industries subsidiary, secured a further order from Russia, for woollen spinning machinery, which is worth over £250,000. Tube Investments' subsidiary, Brookes (Oldbury), received an order from V/O Stankoimport, Moscow, USSR, for two double internal tube polishing machines complete with dust extraction equipment and necessary ancillary equipment. Earlier in the year the Steel Tube Division of TI received Russian orders for stainless and alloy steel tubes worth more than £2 million. Another large order from Poland has been placed by Centromer (Central Import and Export Office for Ships and Marine Equipment) for marine radio equipment with Marconi International Marine Communication Company Limited. The equipment, worth over £100,000, consists of transmitters, receivers, direction-finders, echometers and other items needed to provide complete radio installations for 24 ships to be built in Polish shipyards for delivery to Indonesian owners.

China has also begun to place orders in real earnest. One, to a value in excess of £1 million, has been placed with Firth-Vickers Stainless Steels Limited for " Staybrite " steel, which is likely to be used by China in the development of industrial and chemical plant. The following account by the overseas sales manager of the company, Mr. Derek Gill-Davies, is indicative of the general reaction of British firms to East-West trade: " This order is very gratifying. Due to increased production we are able to supply it without dislocating home deliveries. It will also help to keep full employment going in Sheffield. Our negotiations with the Chinese have been extremely friendly and we are hoping for more orders from them."

New German Boom

A strong expansion of demand during the autumn has been forecast by the West German Ministry of Economics, particularly in the capital goods sector of industry where " production might not keep pace with demand." The ministry's report notes that new export orders are coming in at a rate substantially higher than a year ago, as were imports into Germany.

The evidence for this renewed boom is not yet contained in official statistics. For example, the ministry expect prices of producer goods to rise but the index for August (1950 = 100) remained unchanged at 124, compared with 125 as last year's monthly average. Prices have already risen in some cases and delivery periods have been lengthening. This is most marked in steel, where some of the upswing should be discounted since it is largely the result of re-stocking, and of the high level of American import demand due to the prolonged strike there. There is also contained in the German steel boom what the ministry describes as " indications that the capital goods industry was basing its plans on the expectation of continuing expansion of demand both at home and abroad."

On the consumer sector there was no evidence of excessive demand. Private incomes were rising only moderately and savings continued high.

At Home

KITCHEN HELPS

Of all the gadgets that have been produced as man's effort to assist in woman's chores, very few have survived more than a few short years or even months. Throughout the country cupboards must be filled with gadgets (so many of them bought at exhibitions!) that are no longer used. For so many of them the plain reason was that they were more trouble than they were worth.

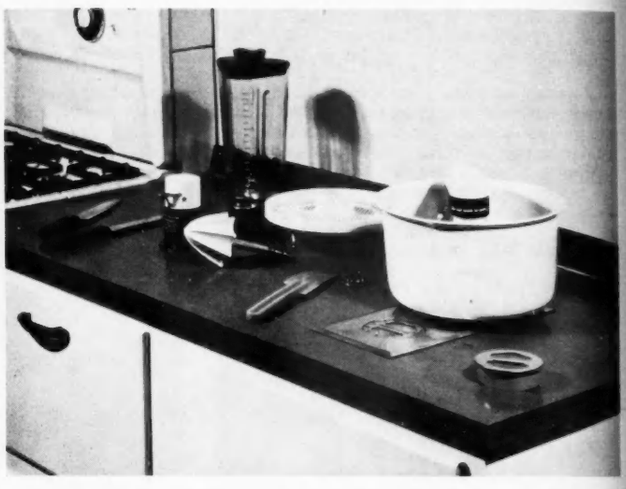
The oldest of all is the roasting spit which has recently reappeared in a glass and chromium version. Of the others, the oldest that has survived is probably the mincer, and its cousin the sausage machine. References to these two items go back quite a long way. Indeed a patent was taken out in 1811. A rival to them in age is the eggwhisk which has been through so many changes that the older models would not recognise the later ones as even belonging to the same family. But it has been since the turn of the century that the business of kitchen gadgets has really got going, pushed along during the last few decades by the great social changes that have occurred.

In spite of all changes, however, the same criterion applies—does the gadget really save time and labour? Does the work it performs really compensate for the bother of getting it out of the cupboard, fixing it up, and then cleaning it and putting it away? If it does not, then just another item goes into the back of the cupboard there to stay till it is reluctantly thrown away some while later.

As a result, the single-purpose tool has become unpopular and the trend today in the kitchen, as in factory at large, is towards multi-purpose items built on the unit construction principle. Directly in this line is the Power-Maid now being made in this country by Cannon. Like so many labour saving devices it originated across the Atlantic. It fits well with the streamline kitchen as the actual power unit is mounted below the working top, and the cover with the control switch in it lies flush.

The motor and controls are housed in a box 10 in long by 4¼ in wide by 6¾ in high. The cutout in the table top should be 10⅜ in by 4¼ in. A single control switch gives six motor speeds. The great advantage is that each unit is simply plugged into a socket revealed by lifting a lid so that the work of getting out and putting away and washing up is directly equivalent to the amount involved in using traditional bowls, spoons and forks.

At present there are five attachments available, but more are promised. The five are: a blender that is said to purée, grate, beat, chip, liquefy or whip, as well as blend. It is triangular in shape, which is claimed to make it easier to handle, and has stainless steel blades that are sealed in the bottom for safety. The food mixer has a five pint bowl in which is a beater. The beater can be set in any one of six positions so that there can be easy access to the mixture during the mixing. In addition, the bowl revolves in the opposite direction to the beater so that all portions of the mix are brought to the blades. It is particularly claimed that the bowl is easy to hold and that it has an all-round pouring rim.



The driving motor for the Cannon Power-Maid is mounted below the surface of the work table and the attachments are simply plugged-in. If it is not convenient to spare space on the working table top the power unit can be mounted on a shelf in a drawer and the attachments stowed beside it. A single control switch gives a choice of six driving speeds. The attachments include a blender, mixing bowl, and coffee mill.

Another attachment is a juicer that is used in conjunction with the bowl and a strainer; its object is to remove all juice from oranges or lemons, the pulp and pips being retained by the strainer. The fourth item is a knife sharpener which sharpens both sides of the blade at the same time. The flexible grinding discs run at high speed, but it is claimed that the knife does not overheat and so lose its temper.

The most recent addition is a small coffee mill that is also said to chop nuts and produce icing sugar from ordinary sugar in a matter of seconds.

From the point of view of the kitchen designer the Power-Maid offers the advantage of requiring very little table space; in fact it can be mounted in an odd corner. The attachments are said to need only the space equivalent to the large basin for their storage. For those cases where even the small amount of top space required is still too great to be conveniently spared, the unit can be mounted in a drawer and the attachments stowed beside it. The principle seems to be one that could well be extended and elaborated.

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